PLATE 1—Tea Leaves, Buds, Flowers and Seeds

THE SPHERE OF TEA

BEING

A Brief Treatise on the Cultivation, Manufacture & Trade of Tea in India.

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PREFACE.

There is at present no up-to-date handbook for tea planters and distributors or those who desire to get a clear insight into the entire industry as conducted in India. Only a portion of the required information is available from a few old high-priced books which are going out of print and there is scarcely any literature on this subject published by the Scientific Department of the Indian Tea Association The little that has been issued by this body is not available except to the members of the Association.

In such a deplorable dearth of knowledge on a leading industry of the world, it is very desirable to issue a clear and simple exposition of this subject including briefly the latest improvements in it. Fortunately the author had some practical experience of tea planting and manufacture in the opening years of this century at the Wingfield Tea Estate (known in its early days as the Salbaree Tea Estate) at Salbaree near Sookna in the Darjeeling Terai.

Since those awakening times, the writer has seen much development in the industry both on the Darjeeling hills and in the Terai plantations Still there is no record of them and much of the valuable experience thus gained is being lost by the passing away of the older generation of planters

To rescue such knowledge from oblivion and to place the latest ideas on tea culture and manufacture in the smallest possible compass, this little book has been written. It has no pretensions to an exhaustive treatment of the subject. Here I have to acknowledge with gratitude the assistance I have received in my work from Mr Stanley D. Sinclair, of the Stein Thal Tea Estate, Darjeeling, as well as from Mr. T. P. Banerjee, of the Happy Valley Tea Estate, Darjeeling

Darjeeling,
17th June, 1933.

THE AUTHOR.

THE SPHERE OF TEA

ITS CULTIVATION, MANUFACTURE AND COMMERCE.

CHAPTER I.

A WORLD PRODUCT IN MODERN TIMES.

LINNAEUS, the Swedish founder of botony, described tea in 1757 as a single species under the name of *Thea sinensis* in his Species Planterum. Later on it was found that two distinct varities were grown in China, which he named *T. viridis* and *T. Bohea.* These were long thought to be the origin of green and black teas respectively—a mistaken notion as will appear presently. In 1823 Bruce discovered tea growing wild in Assam, and its tea tree was named *Thea assamica,* or, as it is now called *Camellia Thea.* Many botanists of the day regard this tree as the parent species of all cultivated forms.

Prior to Bruce's discovery, the China plant was known to the world for centuries extending even to remote antiquity. In consequence the home of the tea plant was believed to be in China. But some botanists explain that no strictly wild plant has been found in China while the Assam tree is indigenous and grows wild all over the province It also attains extraordinary luxuriance in Assam, and arguing that in its natural habitat a plant reaches its greatest development, these botanists maintain that Assam and not China is the home of tea Botanists of the opposite view, however, contend that plants have been known to grow better in foreign lands than in their own homes under more favourable conditions of soil and climate. History yields no clue to the settlement of this dispute and so there will be no end to this controversy.

Confusion in the botony of tea seems to be due partly to the long disputation that raged over the plants from which green and black teas were made in China Formerly foreigners could scarcely visit the Celestial Empire and information on these points, being

entirely from hearsay, was conflicting. Early in the 19th century, however, Robert Fortune, a botanist, cleared up the mystery by investigating the subject in China itself on behalf of the British Horticultural Society. After some difficulty he obtained the permission of the Chinese Government to travel in the tea districts. *T. Bohea* has got its name from the Bohee hills in the province of Fokien where only black tea was known to be produced, but Fortune found both black and green teas being made throughout the tea districts indiscriminately

In his book *Wanderings in China*, Fortune relates thus: "Here were then green-tea plantations on black-tea hills and not a single plant of the *Thea Bohea* to be seen Moreover at the time of my visit, the natives were busy employed in the *manufacture of black teas* Although the specific differences of the tea plants were well known to me, I was so much surprised, and I may add amused, at this discovery, that I procured a set of specimens for the herbarium and also dug up a living plant which I took northward to

Chekiang. On comparing it with those which grow on the green-tea hills, no difference whatever was observed."

"It appears, therefore," continues this botanist, "that the black and green teas of the northern districts of China (those districts in which the greatest part of the teas for the foreign markets are made) are both produced from the same variety, and that that variety is the *Thea viridis,* or what is commonly called the green tea plant On the other hand, those black and green teas which are manufactured in considerable quantities in the vicinity of Canton are obtained from the *Thea Bohea* or black tea." Thus it was proved by Fortune that the distinction between the green and black classes of tea, as they were then exported to England, was not due to any specific difference in the tea plants but was the result of a difference in the methods of manufacture and this verdict holds good to this day

Doubtless the tea industry originated in China whence it probably spread to Japan first and then to other countries in the East Tea was probably used only as a medicine (for

colds and coughs) even in China until the middle of the 6th century A. D , for its use as a beverage in that country seems to have begun about 550 A D. Gradually the use of tea spread to Japan, Tibet, Indo-China and Oriental countries. A knowledge of the proper use of tea was first acquired in England about the middle of the 17th century, thence it spread to Russia and other parts of Europe. Tradition relates that a packet of tea was received from China by an old couple in England during the reign of Queen Elizabeth. Instead of infusing the leaves and drinking their liquid, they threw away the coloured extract and ate the leaves after spreading them on bread

In 1657 a tea-drinking house was opened at Exchange Alley in London and from this date tea began to be used as a regular beverage in England. Samuel Pepys in his famous Diary, dated 28th September, 1660, describes the drinking of tea from China at this house, stating that it was "good for cold and defluxions" When the use of tea spread in Europe, its cultivation began to expand in the

East Japan seems to have taken to this industry on a commercial scale early in the last century, producing for the most part green tea which forms the bulk of her own consumption Japan has also introduced her green teas on the American continent to which she exports her famous grades known as Gyokuro ('pearly dew') and Sencha (a popular quality)

The early history of tea in the East is shrouded in obscurity and the slender facts hitherto recorded (as in the case of all ancient and medieval history) are by no means to be relied upon as definite Though tea is said to have been grown in Japan during the 9th century A D., it is strange that black tea manufacture was confined there only to the island of Formosa where the Oolong quality (a black tea with the flavour of green tea) is prepared. For this slow progress the reason is said to be that the Japanese, who adopted the Chinese methods of tea growing and culture, did not well understand the difficult process of 'fermentation.' Anyway, next to Japan the cultivation of tea seems to have been taken up in Java about 1828.

Suggestions to cultivate tea in India were made as early as 1788 by Sir Joseph Banks to the East India Company who were anxious to undertake the venture and made many preliminary investigations Tea was not sown, however, on Indian soil (excepting the wild plants reared by Nature in Assam) until about 1833 when experimental farms were planted in the district of Kumaon in the central Himalayas—the seeds used being imported from China. Shortly after this initiation, the discovery of Bruce was recalled, and a Scientific Commission including Wallich and Griffiths, both botanists, were sent to Assam in 1835 to report on the possibilities of the wild tea there.

Speaking of the conclusion drawn by this expedition, Mr. P H. Carpenter, Chief Scientific Officer of the Indian Tea Association remarks as follows: "They reported that the Assam bush was a cultural variety of the China bush, meaning that if the large-leaved Assam plants were cultured for long enough, they would gradually change into China bushes. On this account China plants were

grown first of all and the strain introduced into many of the Assam varieties This unfortunate introduction followed on the meagre botanical knowledge at the time " In those days there was little possibility of seed-selection and certainly no knowledge of immune or high-yielding varieties "In 1837 and the years immediately following," observes Mr. Alexander Ibbetson, " discoveries of extensive tracts of country in Assam bearing the indigenous tea were made, and in 1838 the first consignment of Indian tea, consisting of 488 lbs was sent to London, the price obtained being 9sh 5d per lb. "[1]

Though it is reported that the first production was somewhat crude, it was obviously welcomed as a rarity owing to which a high price was paid for it After this lot, shipments of better cultured Indian teas went to London from time to time By 1854 the Indian export had risen to a quarter of a million pounds—a remarkable success within 16 years. Obviously the reason for such good fortune was that in a cold climate a beverage less innocuous and

[1] *Tea* by Ibbetson, London, Pitman, p 40

PLATE 2—Tea Bushes in a garden at the foot of the North Eastern Himalayas

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cheaper than alcoholic drinks was really needed At the outset the men ridiculed the idea of replacing beer and porter by this decoction, but the weaker sex preferred it and probably saw in it a chance of making their intemperate husbands more sober. Hence the housewives in the British Isles seem to have decided the fate of tea in its favour as a commercial commodity, and from these Isles the use of tea spread gradually to other parts of Europe

During the middle of the 19th century tea planting was begun in Cachar, Sylhet and other places in the Surma and Brahmaputra Valleys when the famous Assam Tea Company came into existence. Tea planting in the Darjeeling district commenced about 1858-59 Its example was followed by the Darjeeling Terai, the Nilgiris, the Eastern and Western Dooars Meanwhile its cultivation spread on a small scale to the Kangra Valley, Dehra Dun, Chittagong, Ranchi, Mysore and Travancore North-Eastern India now produces about half the tea consumed throughout the world, and this is largely due to the propaganda which its British planters financed to

the extent of about £ 1 million through the Indian Tea Cess Committee

Ceylon had been growing tea mainly as an experiment since the middle of the last century, but coffee was the favourite crop of the British planters in that island until the sixties when a terrible fungal disease attacked the coffee plantations. In a few years it became evident that coffee was doomed and so the planters with broken fortunes cast about for some better product After experimenting with crops like cinchona and cardamom, they took to tea as the only permanent means of repairing their bad luck. A factor which helped the adoption of tea cultivation in Ceylon and its rapid expansion in India during the seventies and eighties of the last century was an improvement in the exchange value of the pound sterling in which both these countries are paid for their tea exports

Prior to the two aforesaid decades the pound was worth only about Rs 11 in India and Ceylon while during the period it rose to about Rs 18 More rupees to the pound sterling meant more profit to the planters after

paying for labour and other charges here. Early in 1895 the exchange value of the rupee was only 1s. 0½d (in other words, the £ fetched above Rs. 19) in spite of the Indian mints being closed to the free coinage of silver in 1893. On the face of it, it would appear that an appreciated pound (which means a relatively depreciated rupee) favours all exporters of agricultural products (including the Indian peasantry) who *get paid* in sterling, while such an exchange handicaps importers in India who have to *pay out* in sterling Such an exchange means the £ at least @ Rs 15 and above, i.e : @ 1s 4d and downwards This is however a *prima facie* argument. The exchange problem is too deep and intricate to be discussed here. Suffice it to say that the present slump in the tea industry would disappear, at least for a time, if the ratio were fixed @ 1s 4d instead of @ 1s 6d.

A root cause of the present tea depression is the flooding of the world's markets with the cheap teas of Java and Sumatra In fact it is well-known that the European with the Asiatic planters in the Dutch East Indies have wreck-

ed the great rubber industry as well as introduced cut-throat competition in sugar and tea by their cheap over-production. Production should instead be always regulated so as to adjust itself as far as possible to the needs of consumption. Until producers learn this economic wisdom, they will ruin themselves periodically by man-made crises. No longer can the old freedom of unregulated production continue to any advantage. Henceforth all production should be controlled so as to stabilize prices and banish the old silly notion that trade must have frequent vicissitudes and periodic crises.

Tea has been grown in Indo-China apparently since the last century, but its production there seems to be of little consequence either in quality or quantity About 1877-78 tea began to be sown on a commercial scale in Natal, South Africa, but all its production, mostly of an ordinary quality, is consumed locally. The season there begins in September and lasts until June during which period each bush is picked about 16 times. Of course, the seasons are reversed during the year in countries south of

the Equator, relative to those in the north, and in Ceylon the tea season goes on throughout the year.

During this century tea cultivation has been experimented with in various parts of the world, such as in the Caucasus, east of the Black Sea, in Jahore in Malaya, in the north of Florida, in Jamaica, Tahiti and the Fiji Islands. In the first-named place it has received much attention and it may now be said that a tea industry has been established in the neighbourhood of Batoum by the Government of the United Soviet Socialist Republics But labour is scarce in this region and its climate does not seem to have the humidity or mildness requisite for the growth of good tea.

CHAPTER II.

THE SCIENTIFIC CULTURE OF TEA.

IN its uncultured state, the tea plant grows like many small trees to a height of about six feet in a shape that may be called elongated different from the conifers. as in Assam. But the object of its cultivation is to prevent the growth of branches so that all its development may be directed to the production of leaves which have the most value in commerce. Consequently when the plant attains maturity. it is subjected to vigorous prunings every year so that it always remains a bushy shrub of an average height of three feet.

The leaves of the tea plant vary in size and also very slightly in shape according to the variety—the China plant having smaller leaves than the Assam plant. But its leaves are always leathery to the touch with a toothed margin known botanically as 'dentate.' They are usually lanceolate and sometimes elliptical in shape In the body of the leaf

there are oil glands which contain an essential oil to which is due largely the flavour which tea possesses. In young leaves the under surface is thickly covered with fine hairs which begin to disappear with advancing age (See *Plate 1*).

In the axils of the leaves occur flowers, either singly or in clusters, which are slightly fragrant and usually white in colour but sometimes rose tinted These beautiful flowers are succeeded by more or less globular fruits composed of capsules divided into 3 sections, each of which contains a seed generally. (*Plate 1.*) How careful a process is seed-selection will gradually appear, for only seeds obtained from selected plants grown in a special seed garden are used in nurseries.

When the green leaves of the plant are made into tea in the factory, the black or green tea (as known to commerce) is analysed chemically to ascertain what the quality of its beverage will be. Green tea is seldom subjected to such scrutiny, being consumed mostly in the East, but black tea, especially of the higher grades, has to undergo frequent analysis Of

the chemical constituents of tea, the most important are its theine, essential oil and tannin upon which depend its refreshment and to an essential degree its flavour and liquor. Theine is an alkaloid said to contain a stimulating and refreshing property It is found also in coffee and kola nut Usually in tea derived from young plants there is a higher percentage of theine, while in tea obtained from old plants there is a higher percentage of tannin.

Experience shows that in a warm climate an infusion of tea in boiled water for about five minutes is enough to extract all the valuable theine, but a longer infusion extracts all the tannin which is bad for digestion. In a cold climate, with temperature below 60°F, a longer infusion may be given Of these chemical constituents, the quantities depend mainly on the variety, age and culture of the plant and to some degree on the process of tea manufacture. A fair average of tea analyses, quoted by Konig, has shown the following constituents:—

Nitrogenous Substances ..	21·22%
Woody Fibre .	20·30%

Other Nitrogen-free Matter	16·75%
Tannin .	12·36%
Water ..	11·49%
Gum & Dextrin ..	7·13%
Ash ..	5·11%
Fat, Chlorophyll ..	3·62%
Theine ..	1·35%
Ethereal Oil ..	·67%
	100·00%

In the beverage there should be no acrid taste nor blackness of colour Tea is not a food but a stimulant It is drunk for its pleasantness and not for its strength, although many prefer to have some body in the liquor Since a planter always tries to produce good tea for the high price it would fetch, the chemical analysis along with the tasting of tea should be resorted to frequently. There could be no better tests employed in a tea concern, the results of which would always indicate some weak points in the field or the factory.

To aid planters in the scientific culture of tea, the Scientific Department of the Indian

Tea Association was formed in 1900. At first its laboratory was located in the Economic Section of the Indian Museum at Calcutta, but later a small station was opened at Helleaka in Assam which in 1911 was moved to Tocklai near Jorhat. During this century science has been applied to tea culture wherever it is grown largely In 1902 a tea station was founded in Java by the Dutch who have established some of the best agricultural stations in the world at Passaroen, Buitenzorg and other places in the Dutch East Indies. In subsequent years tea stations have been founded in Ceylon and South India.

Scientific agriculture should not, however, lead to over-production and such keen competition in an agricultural industry that prices will be lowered below the cost of production At present the Tocklai Station of the Indian Tea Association contains chemical, mycological, entomological and bacteriological laboratories—the three last sections being intended to fight against the many enemies of the tea bush in the organic kingdom though their attacks may be rare Besides these labo-

ratories, the Scientific Department of the Association has about sixty acres of tea under experiment both at Tocklai and at Borbhetta some two miles apart. Usually experimental work in the field is of primary importance and then come experiments in the factory to undertake which a model factory, driven electrically, has also been erected at Tocklai. A similar scientific institute may now be established at a more central place for the convenience of planters in the Darjeeling district, the Terai and the Dooars.

The aforesaid Department has proved almost indispensable to tea planters in North-East India and many of their difficulties, due to a mere empirical study in the past, have vanished owing to the enlightenment it has brought to them. A brief review of the work of this Department, written by Mr. P H. Carpenter in December 1928, may here be given. The object is that, at the outset of a tea study, it is necessary to know how some of the old theories in tea culture have been subverted Science is making such rapid progress that even some of the practices of the day are being

questioned. Reports are published periodically by this Department which are of no small value to tea planters especially in the above-named part of India.

"One of the first things accomplished by the Scientific Department of the Indian Tea Association," relates Mr. Carpenter, "was to increase the use of manures in the Tea Industry. The earliest manuring took the form of top dressing and the application of cattle manure. Oil-cake followed and then animal meal and finally artificials Now-a-days the industry in North-East India spends roughly Rs 50 lakhs annually on artificials, and the prejudice against what were once considered harmful plant stimulants has practically vanished The plots of Borbhetta which receive year after year only artificial manures and thrive on such treatment are convincing proof of their efficiency.

"The next step was to get the planter interested in dead bushes. A careful study of the fungus diseases attacking tea and practical demonstrations of the possibility of stopping the spreading of such disease by proper treat-

ment led to active steps being taken by planters. A dead bush now-a-days is a matter for concern. The spraying of whole gardens with fungicides and insecticides is now common. The study of insect pests proceeded, parallel to that of fungus diseases. The actual damage done by pests, previously blamed with any crop decrease, is now better recognised Pest control is now generally practised

"So far as plucking and pruning are concerned, planters are themselves experts at both operations. In spite of this, however, very diverse opinions are held and a careful study of methods along scientific lines has shown that the treatment of a bush must vary with varying conditions. No hard and fast rule regarding field work can be laid down.

"The Scientific Department has done much to change ideas on cultivation in tea. This is curious in that cultivation is certainly the oldest agricultural practice in the world. The planter's greatest trial is weeds in the tea and formerly the method of tackling the problem was to *hoe* as often as possible. Experiments have now shown that stirring the soil is

not the main factor in crop production but rather weed suppression. It is now-a-days sought to control weed growth by utilising the shade of the tea bushes themselves, rather than with the hoe. A clearer understanding of the problem has made its solution much easier.

"In the factory there are so many variables that a scientific training is almost essential to the carrying out of significant experiments As time has gone on, the Scientific Department has narrowed the range of temperatures, etc. relating to manufacture till now the best conditions of manufacture are defined within limits

"The function of the Scientific Department is a triple one. Fundamentally and essentially its work is research in the academic sense but subsidiary to this is the collection of facts, the examination and criticism of the same and the drawing of conclusions Since exact conditions are never repeated in agriculture, the collection of facts is never ending and views must be continually modified. The third function of the Department is the dissemination of the scientific knowledges in an assimil-

able form to the tea industry. That the importance of this is fully realized will be understood when it is stated that three instructional courses for planters are held annually at Tocklai. There are about 250 visitors each year.

"Planters as practical men are naturally most interested in the field trials in which, not only are continuous experiments carried out over a number of years, but accurate yields and observations are kept on each individual plot The future of tea tends towards intensive cultivation During the past 25 years the yield in North-East India has doubled and in the best districts almost trebled. Plant selection, manuring and better field methods will ensure still further increases.

"So far as the factory is concerned, the tendency is to standardise manufacture as far as possible Although it is difficult to devise scientific tests which the planter may apply in the factory to determine when one process shall start and another finish, conditions have been worked out so that a definite range of times, temperatures and weights are avail-

able as a guide for making good average tea."[2]

There can be no question that scientific progress has no limitations As rightly observed by Mr. Carpenter, 'the collection of facts is never ending and views must be continually modified.' Still it has to be admitted that much has already been achieved by the efforts of the Department. Planters cannot possibly undertake research and experiment, nor are they fully equipped for these functions scientifically.

In the Department, the scientists not only know the latest developments in plant physiology, agricultural chemistry, mycology, entomology and bacteriology, but they apply the new knowledge to tea culture. After research they arrive at definite conclusions which they test by experiments. When unquestionable improvements are expected from theory and practice, the information is imparted to planters in an intelligible form. All this work has brought the Indian tea industry to a leading position in the world

[2] *"Capital" Indian Industries and Trade Supplement*, 13th December 1928, Calcutta, p 83.

PLATE 4—A Tea Estate in a Himalayan Valley showing garden, factory, withering shed, etc

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CHAPTER III.

THE OLD SYSTEM OF CULTURE.

THE modern methods of tea culture, however developed at the present day, have originated from the old system that was employed in China. Centuries of experience and observation had taught the Chinese a procedure that served to turn a serviceable product, as in the case of all agricultural produce before the advent of Science Science itself has evolved from observation, experiment, supposition, research and tests. It is a more accurate and enlightened type of knowledge than an empirical study which is based mostly on experience gained in a casual manner.

Yet both the empirical and scientific systems have the same principles especially in a very old craft like agriculture which is still pursued by peasants all the world over by ancient methods improved in some cases by the aid of science. It is true that in the tea industry these developments have been almost revolutionary. In any case our knowledge of this

culture should begin with a study of the older and fundamental system conducted in China. It is reported that almost every cottage in the tea districts of the recent Celestial Empire had its own little tea garden, so that tea production probably attained the distinction of a national industry during the last regime.[1]

Apparently the Chinese tea planter of the last century was not acquainted with plant physiology other than the rudimentary fact that the plant acquires its sustenance from the soil and air. All these planters seemed to know this fact and so they evolved an agricultural practice to provide the plant with food and drink through the roots and leaves They took great care that water, air, sunshine and manure were provided usually by natural and sometimes by artificial means, also that the body of the plant was attended to from its infancy according to its requirements

Moreover, these planters knew that the crop of the tea plant consists of its tender leaves so that these had to be cultured especially Hence, after its infancy, the plant was

[1]Vide Ball's *Tea Cultivation in China* published by W. B Whittingham & Co, London, 1848

pruned every year so that it became a bushy shrub full of leaves at maturity. Leaf plucking began rather early, that is, when the plant was about three or four years old It commenced about the middle of April when there were frequent showers of rain. The first crop of leaves was taken from those around the buds as they were about to open These yielded tea of a very delicate flavour which was usually presented to friends.

Under the influence of alternate rain and sunshine, growth continued and the plants rapidly put out fresh shoots and leaves. When this happens, the tea bush is said to 'flush' owing to the bright green leaves which then cover its surface This term is used by modern planters in India and elsewhere—not by the Chinese In India the first crop is taken shortly after the first flush. A few weeks later, early in summer, the bushes are ready for the second crop which is usually the best of the season. The third crop is plucked all through autumn, but rarely is a fourth crop taken. The Chinese understood that flushes may be many but crops must be few. On this subject, differ-

ent views are held in modern practice, as will gradually be explained.

Most of the modern processes of tea manufacture by machines and improved appliances —now known as *withering, rolling, fermentation, firing* or *drying, breaking, sifting* and *sorting*—take their origin from and embody the principles of the old hand operations employed in the cottages of China It is also remarkable that a system of tea manufacture by hand—which may be indigenous inasmuch as it might have evolved largely out of the natural intelligence of the workers—is practised in some of the villages in the tea districts of North-Eastern India, especially in Assam, the main features of which are similar to those of the hand industry in China

In this Indian home industry, after the leaves are plucked, they are *withered* in the air on gunny cloth until their colour becomes darkish green. Next the leaves are *rolled* by hand and made into balls which are kept in a cool place for two or three days when their colour becomes brownish. Then the half-wet

leaves are dried in mild sunshine so as to cause them to *ferment*. Next the fermented leaves are dried in an iron pan (tawa) over a fire until they become dark brown or black in colour. By the hand process, black tea is mostly made in India much as green tea is mainly manufactured in China The Chinese system, however, seems to be more elaborate and thorough.

Speaking of this system in China, Ibbetson describes it as follows: "After the leaves have been brought in from the plantations, they are placed in a shed or drying house, which may indeed be the cottage itself The fire is then kindled in the furnace and a quantity of leaves thrown into the heated pans and constantly turned over and kept in motion by men and women stationed in front of the pans. The heat immediately causes the leaves to crack and become quite moist with the sap which is given out under its influence, and in about five minutes the process is complete, the leaves having become quite soft, pliable and altogether devoid of their original crispness." This is the Chinese process of *withering*.

The *rolling* process is described as follows: "The leaves are then taken from the pans and placed upon bamboo tables, around which stand several persons who take a quantity of the leaves in their hands and carefully *roll* them on the table in a manner closely resembling the working and kneading of ordinary baker's dough. The object of this process, which lasts about five or six minutes, is to twist the leaves and at the same time to express the sap and moisture which escapes through the interstices of the surface of the table"

Fermentation in the Chinese system is obviously the most careful process, much as it is in the modern system "In the next stage of the process," says the aforesaid writer, "the object is to expel the moisture as gradually and gently as possible, retaining the softness and elasticity of the leaves to the fullest extent This is effected by taking the rolled leaves, spreading them out thinly and evenly upon a screen made of the strips of ever-useful bamboo, and exposing them to the action of the atmosphere There can be no fixed time for

the completion of this process, which depends entirely upon the state of the weather, but experience has taught the operators to avoid placing the leaves in the direct rays of a powerful sun which evaporates the moisture too rapidly, leaving the leaves crisp, coarse and quite unfit for the next stage in the manufacture."

Describing the *drying* or *firing* process in the Chinese system, the aforesaid writer continues as follows: "The soft and pliant leaves are now again thrown into the drying pans and subjected to the action of a slow and steady fire. It is of great importance that the leaves should not be scorched or burned, and it is the custom for one person to attend solely to the fire while others, standing in front of the pans, mix and agitate the leaves with their hands so that all shall be equally dried As the temperature increases, it becomes impossible to mix the leaves by hand, so small bamboo whisks or brushes are employed, the leaves being thrown up against the sloping sides of the pans and allowed to roll back into the iron portion at the bottom. The leaves gradually

part with their moisture, twist and curl, and after about an hour are taken from the pans to constitute the finished product. Tea so prepared is green in colour."

The final stage in the manufacture of black tea in China is explained by Ibbetson as follows: "Up to the end of the rolling process, the preparation of black teas proceeds upon lines exactly similar to those described above, but after the rolling, the leaves are subjected to a much more extended drying process in the open air, the period lasting for two or three days. The difference in the colour and character of the teas almost entirely depends upon the differences in the methods of preparation at this stage, and, * * * it will be sufficient to add that the leaves intended to produce black tea, during this extended exposure to the atmosphere, undergo a process of fermentation which does not obtain in the manufacture of green teas."

"Great care is taken in the final drying or 'firing' of the black teas, an experienced and generally old man being invariably employed to regulate the furnace while the other

PLATE 5—A Tea Garden on the hills, near the town of Darjeeling, showing weeding and clearing

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members of the family keep the leaves constantly agitated in the pans The finished tea is then sorted and packed as in the case of the green varieties."

So far our knowledge of the Chinese system does not seem to be very thorough and it is possible that some of the excellent old art of tea culture and manufacture is lost by the passing away of generations who produced the finest teas that the world has tasted For this loss there was no remedy under the disturbed political condition of China.

CHAPTER IV.

EARLY STEPS IN THIS INDUSTRY.

SITE SELECTION.

THERE has been much discussion as to the selection of a suitable site for tea cultivation, but this problem is many-sided and involved in a commercial aspect which is almost ignored In this connection the primary consideration are *climate, soil, labour* and *means of transport* when the species to be cultivated has been decided Consequently the world's tea market must first be regarded At present cheap teas of the Assam species, grown in Java and Sumatra, are being over-produced This tendency will probably continue in the near future and it is not advisable to add to it. Moreover, though inferior teas are in much greater demand than superior teas, they pay less than the latter

For these reasons, there seems to be a greater scope for superior teas at the present day Then, if the health of the planter and his staff is to be considered, a temperate and moist climate like that of the Eastern Hima-

layas or the hill tracts of Southern India—in which the acclimatized varieties of the China species may be grown—seems the most desirable. *Climate* is a very important factor in site selection, but it is subservient to commercial requirements. The China and Assam species require different kinds of climate. The valleys of Assam in which tea is grown are only a few hundred feet above sea-level with a warm and wet climate. If the former species is to be cultivated, a temperate climate with a moderate rainfall is required; if the latter, a warm and wet climate is essential.

A suitable site for the China species should have a rainfall of about 100 inches in the year, at least 25 inches of which should fall in the spring, that is about March, April and May when tea leaves begin to grow by alternate rain and sunshine. There is enough of mist in the Eastern Himalayas but it does no harm to the tea plant Frost is not good for tea, however, but fortunately the plant is pruned in the winter when this occurs. Snow and hailstone are even worse for tea, but they seldom or never occur in the districts referred

to Sunshine is good for tea, but there should be no prolonged drought. High winds also should be avoided if possible by the selection of a protected site or a region where they seldom blow.

The *soil* required for tea should be light, rich and friable. Tea thrives best in such soil, although it grows in others Ball in his book on *Tea Cultivation in China* says much on tea soils, but the author has collected opinions which are sadly at variance and on the whole teach nothing A light soil is usually mixed with sand, as opposed to a clayey soil which is stiff The surface soil up to a depth of about five feet, required for the descent of the tap root, should be light. The subsoil may be clayey A rich soil has decayed vegetable matter on its surface such as the virgin soil of forests. A friable soil is easily divided into its component particles and is naturally porous, admitting and expelling water freely The light rich loam of the Kumaon district in the Central Himalayas—with a ferruginous reddish subsoil—was originally selected for tea in India.

In site selection, the lay of the land is a matter for some sensible forethought. On the plains of Northern Bengal, such as the Dooars and the Terai, or on the table-lands of the Assam valleys, a good system of drainage is necessary in a plantation as there should be no stagnant water under tea bushes. On the hills where tea is planted on sloping land, the drainage system is a simple matter, but on such hillsides the avoidance of soil-denudation sometimes becomes a problem in the heavy rains. To avoid such a possibility, the soil over the roots of bushes should not be dug up before the monsoons, or when this is necessary, the loose earth should be replaced and allowed to settle down as before Soil-denudation carries away much of the chemical constituents that feed the plant and so it should not take place

Soil-denudation however occurs but seldom even in the hills unless the earth is loosened or tea is planted on a very steep slope—neither of which should be permitted If planters were so thoughtless, tea could never be cultivated in the hills In extraordinary cases

of surface ground nudation, soil-pits may be dug in the lower slope to catch the soil-wash which has again to be replaced by extra labour In the hills, where tea is sown below a forest, soil-denudation is apt to be replenished by the soil-wash from above But as a matter of fact, rain water in the hills usually joins with the natural system of drainage in the mountain streams, unless there is an actual land-slide.

Labour is a very important factor in the tea industry considering the large number of hands required to conduct a plantation with a factory. Assam and the Dooars—the two largest tea provinces in North-Eastern India —are rather unhealthy and thinly populated and so are very largely dependent on imported labour from the Central Provinces, Bihar and Orissa. The expense of this system is great and so is a great handicap to these regions Elsewhere in India, even in the Terai, Darjeeling District, Chittagong and the Nilgiris, local labour is usually available While such is the case, each cooly imported into Assam or the Dooars costs about Rs 50 ere he arrives at

the garden and does any work. After arrival, he has to be housed, cared for and treated when sick, to be paid when ill or working, to have work found for him or paid to sit idle when there is no work.

In addition to all this expense and responsibility, every death or desertion is a loss to the garden of the money expended in bringing the man or woman. Contrasted with this system of immigrant labour, local labour is far more profitable. In most cases, no expense is incurred for housing as the workers come from the adjacent villages and no expense is involved for treatment as the labourer remains at home when sick There is no loss by death or desertion. When there is no work in the plantation or factory, the labour is simply not employed. Moreover, local labour understands local conditions and is easier to train up than immigrant labour. For these reasons, local labour is far more preferable to and very much cheaper than imported labour, a reason why tea-planting in Assam or the Dooars is not very alluring until there is more deforestization, sanitation and riddance of their fevers.

Transport facilities in the hills are of course less than in the plains, but the advent of motor transport has removed much of this difficulty. With the improvement and construction of roads, transport will be still better in the future However, it is certain that in this respect the plains have the advantage over the hills however slight it may be.

LAND CLEARING AND PREPARATION.

Forest lands are usually selected for tea planting owing to the richness of their soils. Grass lands, though cleared more easily, are less fertile and so are not touched, unless necessary for the extension of a garden To some extent, the timber and firewood obtained by clearing a forest, repay for themselves If not saleable in the locality, they are sure to be required in course of time for the plantation. The mere cutting down of trees, leaving their stumps in the ground, is however a dangerous practice because they decay and serve to harbour insect pests and fungi which in time attack the roots of the young tea plant. These stumps have, therefore, to be unrooted and

PLATE 6—Tea Leaf Picking and Plucking at the foot of a hill garden

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with the forest debris should be burnt. Their ashes may finally be used as a manure.

The easiest way of clearing a forest is to dig deeply around the roots of the trees, loosen the earth next to the collars and then pull down the trees. The weight of the trunk and branches uproots the tree. When this is not possible, the tree may be cut down and mechanical extractors used to pull out the stumps and roots. But this is a laborious and expensive method *Uprooting* is the best way of felling the trees A few trees may be left standing here and there to provide shade for the workers in a garden. Portions of the forest may also be left untouched to furnish fuel and timber for the estate in future

In the plains a good system of drainage is essential in a garden In the hills, steep slopes should be converted into terraces approachable by zig-zag paths. Then a garden has to be divided into sections by means of roads The blocks are numbered which facilitates the working of the estate. A central spot, where water is available, should be selected for the factory and manager's bungalow The cooly lines

may be built on waste land. The manager should be in a central spot so that he may be able to readily supervise the work all around. The factory may be put up in the third year after planting.

In the present state of the tea market, new gardens should not be opened in Assam or the Dooars There is room now only for the sowing of the best acclimatized varieties of the China species in the hill tracts of India The older gardens may also extend in this direction to supplement any declining production of good teas. But on no account should the area of inferior production be expanded.

CHAPTER V.

THE MODERN SYSTEM OF CULTIVATION.

HOW PLANTS ARE FED AND TREATED.

IN the scientific age the improvement of tea cultivation has taken place by the systematic study of botony and the development of agriculture. Early in the last century, botony was mainly confined to a study of what is now known as 'morphology' or the mere conformation of plants with some ideas of their anatomy Botanists were at first mostly engaged in classifying plants according to their structure. They found that plant life should be divided primarily into two main classes—*phanerogams* or plants bearing flowers and *cryptogams* or plants having no evident flowers These main classes or phylums were then divided and subdivided into sub-phylums, classes, sub-classes, families, genuses, species and varieties by the fathers of botony like Linnæus, Roxburgh, Bentham, Hooker and Kerner.

During the 19th century the physical consituation of plants was only vaguely perceived. Early in this century, however, the different organs of plants were properly studied by Karl von Goebel in his famous work on 'organography' and the functions of these organs began to be revealed by Sacks, Bœyer, de Bary, Schleiden and others by their investigations on 'plant physiology' In the meanwhile, the study of 'mycology' has revealed the diseases and treatment of plants caused by fungi, the study of 'entomology' has enlightened us on the subject of plant attacks by insect pests, the study of 'bacteriology' on the attacks of bacteria and 'plant pathology' now seeks to study the subject of health and sanitation of plantations in general. Besides agricultural chemistry has enlightened us greatly on the subjects of soil-analysis and manuring

In botony the most important discovery was that the higher plants (the phanerogams) possess chlorophyll, a green colouring substance, with the aid of which by the action of sunlight (a process now termed as 'photo-synthesis') they convert gases from the air and

mineral constituents from the soil into plant food From the economic standpoint, the whole life of the globe depends on the photo-synthetic power of green plants. They alone are able to create in themselves their own food. Non-green plants (including fungi and bacteria) and animals (including insect pests) do not possess this power but are entirely dependent on the green plant for their sustenance. Finally man has to depend on the vegetable and animal kingdoms for his food-supply. This is the order of dependence in the sustenance of life

How green plants, including the subject of our treatise, feed themselves is a part of elementary botanical knowledge and will presently be described. Here it may be added, however, that the researches of botanists are throwing a fuller light on this process. Among others, Drs. G Haberlandt and E. Strasburger have observed in recent years that plants possess what they term provisionally as the mechanical, absorbing, vascular or conducting, storage, aerating or ventilating, motor, sensory, secretory and excretory systems. Prof.

F. O. Bower, twice President of the Botanical Section of the British Association, has summarized the recent progress in this science as follows. "Thus within half a century we see evidence of an extreme sewing of the pendulum, from 1870, when systematic botony ruled and physiology was ignored, to a present position when physiology is advanced by some at the expense of morphology It must be borne in mind that systematic botany is but the methodised product of morphology and morphology the record of continued physiological action. The several branches can never be detached with impunity."

Nature is now yielding her secrets less reluctantly than before and the following facts in botany are well established In the case of most green plants the undernoted generalizations are accepted The *leaves* of a plant are the respiratory and transpiratory organs while they help also in the function of food assimilation Respiration is the inhaling and exhaling of atmospheric gases which takes place mostly through the pores (stomata) in the leaves Transpiration is the exudation of water from

the plant by a stream which arises from the roots and escapes through the stomata The leaves absorb carbon dioxide from the air, of which the carbon goes to form sugar, starch and other food-stuffs for the use of the tree while the oxygen is exhaled and returned to the air

The *roots* imbibe from the soil (through the root-hairs) the water necessary to the growth of the tree together with certain mineral constituents (such as nitrogen, phosphorus and potash) which form part of the food-supply, while they put into the soil certain substances which they do not require Moreover, the roots maintain the position of the tree in the ground. Such being the root functions, when a tree suffers from a root-disease, mycologists say that it may be suffering from the ill-effects of a protracted drought The *stem* or trunk carries the nourishment between the roots and the crown, stores up usually a reserve stock of food and supports automatically the branches and foliage

To a tea planter, the study of leaf structure and functions should be a very important

one, as will appear gradually. Experience has taught this planter that the winter is the only suitable season for pruning, for then the tea plant has a low vitality and the sap is said to be down. Botony has not yet been able to clearly explain the physiological condition here implied as regards the tea shrub, but obviously the suggestion is here made that the ascent of sap is not vigorous in this season There is much controversy yet on the general theory relating to the ascent and descent of sap between roots and leaves This process cannot be compared to 'the circulation of blood' as known in man's physical constitution and no analogy should be drawn between plant and human physiology from preconceived notions as life in the vegetable realm is of a much lower order than life in the animal kingdom

Rightly it may be said that since the 'seventies of the last century revolutionary changes have taken place in the manufacturing side of this industry and this was due to the introduction of the factory system in the preparation of tea from the leaf by the aid of machinery Still it has to be admitted that in

PLATE 7—Weighing Tea Leaves at a garden in South India

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its strictly agricultural side comparatively small changes have taken place in a system of cultivation which has been pursued for centuries yielding good practical results There have been only a few developments on the cultural side The progress of agricultural chemistry has led to better soil analysis and manuring, also two branches of botony and one of zoology have helped the planter to fight against the occasional attacks of the enemies of the tea plant But the researches of physiology and pathology connected with the vegetable kingdom in general have brought no visible help as yet to the tea planter and it is very doubtful if any light will come from this direction in the near future

Doubtless, large-scale cultivation, during the last sixty years or so, has reduced the cost of production even on the agricultural side and this may be regarded as a decided economic development since it has helped to augment the consumption of tea all over the world and make it a popular universal beverage replacing obnoxious drinks All this remarkable progress has taken place by the ingenuity, patient

toil under trying circumstances and dogged perseverance of British tea planters in India whose example may now be well followed by our countrymen As a matter of fact European planters in other parts of Asia and Africa have profited much by the pioneering work of British planters in India while Indian capitalists were only fit to launch out their money in safe and inert landed-property investments or to depend too much on state-aid in industries in a helpless manner.

THE MAIN FEATURES OF TEA CULTURE.

At the outset, a brief sketch of cultivation in general would acquaint the reader with the outlines of tea culture, over which the details could be more easily filled in gradually. To plant out a new garden, seeds are first sown in carefully prepared *nurseries* where they are tended till the rains of the following year. The seedlings are then taken up, each with its little cone of earth adhering to its roots, and *planted* in staked-out rows at regular intervals. After two years the bushes are pruned (i.e. the leaves are sheared) to make the plants spread out and a year later they generally begin to

yield the crop of leaves In the meanwhile, any vacancies caused by the death of seedlings are filled in and the soil between the rows of bushes is turned over by repeated *hoeings*.

With the first rains of April, young green shoots appear on the mature bushes which are said to *flush* This marks the beginning of the tea-making season which lasts till November The shoots and the tender leaves next to them are *plucked* by hand. They are known jointly as leaf and ultimately become the tea of com merce All through the season, flush suceeds flush and the entire labour force is hard put to it to go round the estate and garner each lot of leaf before the next is ready for pluck- ing As a rule, only the bud and the two new leaves next to it are taken Anything more is coarse plucking, which is condemned both as tending to over-production and as turning out a coarser tea that perforce sells at lower prices

SEED-SELECTION.

The puzzling problem of seed selection for a plantation has been discussed ever since tea began to be sown on a commercial scale in In- dia about the 'sixties of the last century.

About 1856 the Government in India imported large quantities of the China seed and distributed it freely to planters who were then beginning to sow tea in certain parts of India. It was then believed that the Assam plant was too coarse to yield good tea and so China seed was sown even in the Government Tea Garden at Kumaon Seed, seedling and plant from this Garden were supplied to planters even in Assam. In course of time, however, planters in the Surma and Brahmaputra Valleys cultivated the indigenous plant and found that it produced quite good tea with a distinct flavour

The Assam leaf is larger than the China leaf having a yellowish or pale-green colour, and its manufactured tea gives a highly coloured liquor (usually of a dark copper tinge) which is liked for its body by many drinkers It is true that the Assam plant itself varies slightly according to the soil, climate and culture it has become adapted to As instances, planters distinguish the indigenous plant of Manipur from that of Cachar. They say that the Manipuri plant has leaves which are more oval in shape, thicker in texture and darker in

colour than those of the pure Assamese plant. Anyway, the hill gardens in India began generally with the China plant which got acclimatized to different conditions, while in the Assam gardens the indigenous species seems to have become predominant or the exotic types acclimatized, with the result that, other than in Assam, most tea plants now found in India are Hybrids

SEED-GARDENS.

Planters sometimes differ in their opinions as to the physical constitution of the Assam and China species, but most of them aver that the former is of a more delicate nature than the latter. They say that the Assam plant requires more careful treatment and everything in its favour while the China plant is more hardy and is grown on almost every kind of soil in its original home. Since there is so much uncertainty as to the possible health and vigour of the plants under given conditions, many estates have *seed-gardens* of their own to test the nature of plants that they wish to propagate But the procedure they adopt is not always the wisest. Often the plants

in the *seed-garden* are never pruned but allowed to grow to their natural shape and height so that they might yield a large crop of seed

By this system another advantage is claimed—that of absolute isolation and difficulty of hybridization, as in a big garden But the great objection to this system is that the conditions of culture in a seed-garden are not the same as in the estate itself In fact, probably owing to want of pruning and proper attention, the plants are often attacked by blights The latest procedure, therefore, is to abandon the idea of a separate seed-garden and select seeds from the entire estate (spread over a larger area and affording a bigger field for selection) where also the conditions of culture would be the same and a mere continuation of the former treatment

CHARACTERS OF THE TWO MAIN VARIETIES.

Before we can proceed to seed selection, the distinctive features of the Assam and China types should be known. In this regard the views of a classic writer on Tea, Colonel Edward Money, are worthy of note. He describes the two plants as follows: "The indige-

nous grows quicker after the second or third year than the China, if it has not been over-pruned or over-plucked when young. In other words, it flushes quicker, for flushing is growing. The indigenous does not run so much to wood as the China. Indigenous seedlings require to be watered oftener than China, for the latter do not suffer as quickly from drought. The indigenous tree has a leaf of 9 inches long and more. The leaf of the China bush never exceeds 4 inches The indigenous leaf is a bright pale green, the China leaf a dull dark green colour The indigenous 'flushes,' that is, produces new tender leaf, much more copiously than the China, and this in two ways: *first,* the leaves are larger, and thus if only even in number exceed in bulk what the China has given; and *secondly,* it flushes oftener. The infusion of Tea made from the indigenous species is far more 'rasping' and 'pungent' than what the China plant can give, and the Tea commands a much higher price

"The young leaves from which alone Tea is made are of a much finer and softer texture in the indigenous than in the China; the for-

mer may be compared to satin, the latter to leather. The young leaves of the indigenous moreover do not harden so quickly as those of the China, thus if there is any unavoidable delay in picking a flush, the loss is less with the former. In the fact that unpruned or unpicked plants (for picking is a miniature pruning) give fewer and less succulent young leaves which harden quicker than pruned ones, the two varieties would seem to be alike. The China variety is much more prolific of seed than the indigenous, the former, also gives it when younger, and as seed checks leaf, the China is inferior in this as in other respects. The China is by far the hardier plant It is much easier to rear, and it will grow in widely differing climates, which the indigenous will not. * * *

"I have now, I think, pointed out the leading characteristics of the two original varieties of the Tea plant, and it stands to reason no one would grow the China who could get indigenous But the truth is, a pure specimen of either is rare The plants between indigenous and China are called 'hybrids' They

were in the first instance produced by the inoculation, when close together, of the pollen of one kind into the flower of the other, and the result was a true hybrid, partaking equally of the indigenous and China characteristics; but the process was repeated again and again between the said hybrid and an indigenous or China, and again later been hybrids of different degrees, so that now there are very many varieties of the Tea plant, 100 or even more, and no garden is wholly indigenous or wholly China * * * * *

AN EARLY ERROR IN SEED-SELECTION.

"Had China seed never been introduced into India, a very different state of things would have existed now The cultivation would not have been so large, but far more valuable The propagation and rearing of the indigenous, as observed is difficult, the China is much hardier while young. So difficult is it to rear successively the *pure* indigenous, perhaps the best plan, were it all to come over again, would be to propagate a high-class hybrid and distribute it, never allowing any China seed or plants to leave the nursery, which should have been a

Government one But we must take things as they are. The Government nurseries in the Himalayas and the Dehra Doon (there have never been any elsewhere. worse and worse sites could not have been chosen) were planted entirely with China seeds, the seedlings distributed all over the country, and thus the mischief was done The Indian Tea is vastly superior to the Chinese, and commands a much higher price at home, but it is still very inferior to what it would have been, had not Chinese seed been so recklessly imported and distributed over the country

"The home of the indigenous Tea tree is in the deep luxurious jungles of Assam and Cachar There it grows into a good-sized tree. I have seen it 20 feet high. These are of no use, except for seed, until they are cut down. When this is done, they throw out many new shoots, covered with young tender leaves, fit for Tea. They are of course far too big to transplant, but on some sites where they were numerous, that spot was chosen for the plantations, and some of these are the best gardens in Assam and Cachar.

"The indigenous plant and high class hybrid require a hot moist climate, and will not therefore flourish in any parts of India outside Eastern Bengal I have tried them in the Himalayas, there the cold kills them. In Dehra Doon and Kangra the climate is far too dry; besides the hot winds in the former, and the cold in the latter, are prejudicial. The Terai under Darjeeling, suits them. In Assam, Cachar, and Chittagong, the indigenous and the highest class hybrids will thrive, for the climate of all three is suitable, but perhaps Northern Assam possesses the best climate of all for such plants.

"The Himalayan gardens consist entirely of Chinese plants mixed occasionally with a low class of hybrid. They were, all formed from the Government Nurseries where nothing but Chinese was reared. Occasional importations of Assam and Cachar seed will account for the sprinkling of low class hybrids which may be found. The same may be said of Dehra Doon and Kangra. In some gardens in the Terai below Darjeeling a high class of plant exists In Assam, Cachar and Chitta-

gong the plantations vary much, but all have some indigenous and high class hybrids, while many gardens are composed of nothing else.

"It is evident, then, that the value of a garden depends much on the class of its plants, and that a wise man will only propagate the best. Only the seed from good varieties should be selected, and gradually all inferior bushes should be rooted out and a good kind substituted." ‡

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‡ *Money's Cultivation and Manufacture of Tea*, published by Whittingham, London, 1878, pp 46—50

CHAPTER VI

SEEDS—THE FOUNDATION OF ESTATES.

THEIR COLLECTION AND TREATMENT.

IN the two chief varieties of the tea plant, there are slight differences in feature and habit though less in structure (morphology) and probably none whatever in functions (physiology). But the seeds of all varieties of the tea plant are about the same in appearance and afford little clue to the recognition of their types. To know for a certainty what plants have borne the seeds you get, you have to make sure of the source from which they were obtained. Then, prior to their use, the hollow and unsound seeds must be rejected ruthlessly. In this connection, 'the water test' is not always accurate because good seeds, when dry would float. The best plan, therefore, would be to remove the capsules and get all the seeds examined carefully by an experienced eye Again, the water test, by moistening the seeds, might hasten their germination.

Only when opening out a new garden, seeds must be obtained from a reliable farm, as such a germinating source could not be cultured in the estate itself at the outset without a delay of some years. But after the first sowing from outside seeds, the usual course is to select carefully the seeds of your own plantation when required for fresh sowings. A separate seed-farm, as already discussed, is an additional worry without adequate compensation If such a farm could be established from the very beginning, there would be merely the justification that you did not wish to get seed from a possible unreliable farm. There are no government gardens now and the farm of the Indian Tea Association may not sell seed to a non-member nor have the large quantity required for a new plantation.

Anyway, the original seed-selection was made for this industry nearly a century ago by Government who have virtually fixed the races of Indian tea. It is for planters now to improve the breeds. The aforesaid Association has indeed laid down some rules for the quality and packing of seeds sold by associated

gardens and so there are some restrictions preventing the sale of worthless seed. But these rules cannot be enforced in practice. In a maund (82 lbs.) the number of dry seeds vary according to type from some 15,000 to 25,000, from which at least 10,000 good plants may be expected. Colonel Money (who is often quoted by Sir George Watt) states that "7 mds. seed, with capsules, give 4 mds clean seed." Also, he calculates that—

Maund of clean seed		Number of seeds
1	(fresh)	would amount to 26,000
1	(10 days' old)	would amount to 32,000
1	(1 month old)	would amount to 35,000

In round numbers, he estimates that 1 md. seed would amount to 30,000 seeds, and that with good seeds, sown shortly after they are picked, about 20,000 would germinate Moreover, he states that the higher the class of plant, the less durable would be the seed and the less in quantity. By a high-class plant, he probably means a pure breed. †

† Money's *Cultivation and Manufacture of Tea*, pp 53 and 55.

The tea flower, which contains the germ of the tea seed, appears in autumn and about 14 months after (i.e. in the following October or November), the seed in it is ripe The seed is enclosed in a thick capsule which contains 1, 2, 3 and even 4 seeds sometimes Since all the seeds do not ripen simultaneously it is necessary to send round collectors to pick up the seeds throughout October and often in November. When the seed is ripe, the capsule assumes a dark green or purple tinge, after which it begins to dry and shrink which causes the capsule to burst and the seeds to fall to the ground Most of the capsules still adhere to the seeds and some seeds do not drop until quite dry Each seed is about the size of a big pea (as found in large green-peas) and its kernel is protected by a hard shell of dark brown colour

Since upripe seeds should not be plucked, they may be left on the plants until they drop of themselves. At the same time, they should not be allowed to remain on the ground for days as the dampness of the soil may begin the process of germination, which, if not con-

tinued, would result in the death of the embryo Capsules that may not have burst, may be dried a short while in the sun or air when they would split Tea seeds lose their vitality rather rapidly and the sooner they are sown in the nursery, after being selected, the better. If possible, nurseries or germinating beds should be ready for the seeds before they are collected

The vitality of seeds may, however, be made to lie dormant for a time with careful handling. This must be done when seeds cannot be sown immediately or have to be sent to a long distance. If the nursery is not ready for their reception, they should be kept in the meanwhile in sand or dry charcoal dust or put into germinating beds in layers covered with dry mould. When they have to be packed for transport, they are put in layers of fine dry charcoal, between sheets of thick paper, in tin-lined cases which are finally soldered airtight In this way, the seeds would keep for months.

THE TWO METHODS OF SEED-SOWING.

In sowing a plantation, there are two alternative courses left to a planter Either

he may culture the seeds first in a nursery and then transplant the seedlings in their permanent spots on the estate, or, he may plant the seeds direct in their final sites, marked by stakes, on the plantation. The latter short-cut system is known as ' sowing in situ' or 'sowing at stake.' In the former (careful though round-about course), the seeds are first sown in the nursery at the end of the year and then the seedlings are transplanted at the beginning of the following rains. In the latter, the seeds are sown at once, also at the end of the year, in the plantation

In the nursery, the seeds can get special attention, being all together in a limited space, which can also be fenced off as a protection against intruders. When required, the seeds can get artificial shade. They have to be watered, the soil round them opened and weeded frequently. All this attention cannot be given so conveniently when they are spread over or scattered about a wide area in the estate. Such close attention in a big field would involve much time and labour. Compared with the conveniences of a nursery, however, must

be weighed the labour of transplanting during the busy season and the loss of at least 3 months' growth by the transference which occasionally (though very rarely in the case of healthy seedlings) results in the death of the plant Moreover, the cost of preparing a nursery must be considered in the roundabout plan Again, by the direct method, if the winter rains fail, the seeds in situ fail to germinate unless watered by hand; and, in any case, the soil around them must be hoed and weeded, also artificial shade has to be given to the seedlings if necessary

The advocates of either plan have much in their favour, but at bottom it is the climate and to some degree the labour conditions in the locality which should decide this vexed question. The better plan in one place may have little or no advantage in another. On this controversy, Colonel Money makes some wise remarks "Planting in situ," he observes, "where it will succeed is by far the cheaper and better, and it will do so whenever there are certainly cold weather and spring rains Thus (see rain table) it will often suc-

ceed in Assam, Cachar, Darjeeling, the Western Dooars, and perhaps the Terai below Darjeeling It will fail in Chittagong, Dehra Dun, Kumaon, Kangra and Hazareebagh In Chittagong, for instance, a garden could never be made by planting *in situ*, or, as it is generally called, at stake. In this and other matters adapt your operations to the existing climate."‡

CLIMATE IS VERY IMPORTANT.

Since winter showers often fail, Money urges the resort to nurseries. Apart from these showers, the rainfall best for tea is 70" to 100" yearly, distributed evenly throughout the season from March to October. But these are ideal conditions—seldom or never fulfilled. In North-Eastern India, the rainfall varies roughly between 90" and 200" according to situation. Observations taken at the Planters' Club, Darjeeling, give the following total annual rainfall for the town thus:—129·30" in 1929, 102·53" in 1930 and 117·92" in 1931. The monthly averages for its environs recorded at a school would come to something like

‡ Money's *Cultivation & Manufacture of Tea*, p 57

the following from 1927 to 1931:—January to March = 3″, April = 5″; May = 8″; June = 23″, July = 31″; August = 24″, September = 23″; October = 5″; November and December = 1″; total = 123″. The average annual rainfall of Kurseong is probably near 180″ and of Kalimpong about 90″. The elevation of these two stations is about the same, namely, 5,000 feet above sea-level.

In addition to the heavy rainfall of the Darjeeling District, sunshine is very scarce there and the hills are usually enveloped in clouds, with very rare glimpses of the sun, throughout the monsoons from June to October The sky is clearer from November to March when the rays of the sun are quite mild In the higher hills above 5,000 feet, a cold and cutting breeze flows in February and rain in March or April often brings on a hailstorm Humidity declines rapidly, however, with the occasional appearance of sunshine in such elevations

BIG TEA AREAS IN INDIA.

Table I. *Elevation* (above sea-level) and *Temperature* (monthly averages in Fahr.°) given by Col. Money who states no year but the figures obviously refer to several years before 1870 (pp. 25-26):—

	Elevation in feet.	January.	February.	March	April	May.	June.	July.	August.	September	October.	November.	December
Goalpara	386	61·7											
Sibsagar	350												
Gauhati	131												
Dibrugarh	366												
Cachar	76												
Chittagong	101												
Darjeeling	6,952												
Hazaribagh	2,010												
Ootacamund	7,190	51·5	52·8	57·3	60·1	60·8	57·9	55·8	56·1	56·1	55·9	53·9	51·9

The lowest temperatures recorded were at Darjeeling town as follows: 32° in January, 28° in February, 39° in March, 38° in November and 33° in December.

BIG TEA AREAS IN INDIA.

Table II Average *Rainfall* for several years before 1870 recorded by Col Money (pp. 27-28) .—

	January	February	March	April	May	June	July.	August	September	October	November	December.	Total
Goalpara	0 42"	0 76"	1 84"	4 85"	11 72"	23 72"	21 33"	12 69"	10 93"	5 61"	0 39"	0 20"	99 44"
Gauhati	0 70"	1 43"	1 48"	7 27"	10 92"	13 29"	13 08"	11 98"	6 82"	3 20"	0 47"	0 12"	70 76"
Sibsagar	1 18"	2 43"	3 77"	10 15"	11 04"	15 56"	14 87"	13 88"	11 13"	4 46"	1 29"	0 69"	90 45"
Cachar	0 50"	3 53"	6 09"	12 69"	16 12"	19 55"	24 58"	16 84"	13 90"	7 77"	7 03"	0 79"	123 3"
Chittagong	0 37"	1 62"	1 31"	5 46"	9 42"	22 92"	22 54"	23 04"	13 01"	5 93"	2 30"	0 55"	108 47"
Darjeeling	0 76"	1 60"	1 65"	3 62"	7 01"	27 50"	29 40"	29 09"	18 06"	6 56"	0 20"	0 14"	129 5"
W Dooars	0 8"	2 0"	1 5"	6 6"	25 3"	27 3"	46 5"	83 5"	46 5"	9 6"		2 4"	252 0"
Hazaribagh	0 42"	0 52"	0 75"	0 42"	1 37"	10 99"	14 63"	11 44"	6 26"	3 51"	0 19"	0 02"	50 52"

In 1869 there were 148 days of rainfall in Darjeeling and 98 days of rainfall in Hazaribagh In the higher altitudes (above 4,000 feet) of the Darjeeling district, there is scarcely any sunshine from June to September. During these 4 months, the sun is often invisible for a fortnight continuously Even during the rest of the year (Oct to May), there is seldom any bright or protracted sunshine These altitudes are, therefore, known as 'the land of mist' for about three-fourths of the year. No other tea area in India seems so deficient in sunshine Though it produces the best tea, this area is unhealthy for workers who cannot get acclimatized to a humidity of 90° to 100° in the air.

In 1899 the total rainfall of Darjeeling town was 168·5″ when 30·54″ fell in June, 42·81″ in July and 41·62″ in September. There were some hundreds of landslips resulting from a fall of about 28″ of rain in some 40 hours during September when a hillside below the Mall Road, with some houses near Pekoe-Tip, was carried down the valley. Though Darjeeling district turns out the highest priced

PLATE 8—A TEA-SEED NURSERY

The seed beds in front require plentiful air and water, those at the back need more of shading which is given by mats placed over iron-frames The nature of a Nursery depends on climatic and other considerations, as explained in the text

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tea in the world, sometimes its heavy rainfall makes it unhealthy for tea workers. Its lower altitudes (below 2,500 ft) are malarious, and its higher altitudes do not suit sufferers from asthma, bronchitis, dyspepsia and diarrhoea. It offers some relief from the sickening conditions that obtain in the Dooars, the Terai, lower Bengal and parts of Assam, but it is by no means so healthy as the hill-stations of the North-Western Himalayas, especially of Kangra and Kashmir.

PREPARING AND SOWING A NURSERY.

In choosing land for a Nursery, some planters prefer a poor soil so as to raise hardy plants which they say would thrive more easily later on in richer soil. They urge that plants improve from poor to rich soil but never the other way, an inference that is generally true; but seedlings cannot be hardened by adverse treatment This view seems to be influenced by the general theory of " adaptability to environment " which is a very vast and intricate subject in the higher phases of evolution, but it operates differently in the many spheres of the organic kingdom.

The view in biology that life must begin under favourable conditions and become gradually used to trying circumstances seems to indicate the wiser course because infant life is more frail than adult life even in the vegetable realm Then, climate is quite as important a factor as soil, which is often ignored; and, soil may be changed but not climate. If an unsuitable clime is selected, the germination of seed and the propagation of seedlings are likely to prove vital struggles

The wisest course seems, therefore, to be the selection of a soil and clime for the nursery, in which the parents of the seed had their habitat When this is done, water-logged land must be avoided and a top-dressing of suitable manure or forest mould may be added finally At first the soil should be thoroughly cleared of weeds, roots and stumps, then dug up to a depth of at least 2 feet, from which all stones, sticks and rubbish must be removed. Next, all lumps must be broken up and the soil pulverized throughout.

"Choose a level site," advises Money, "with if possible the command of water at a

higher level—anyhow with water handy. Either irrigating or hand-watering for seed-beds is a necessity if vigorous and well-developed plants are to be looked for. The soil should be of the light, friable kind recommended for the Tea plant (see 'soil') and of the same nature as the soil of the garden, the ultimate home of the plants. This latter is all-important, for seedings will never thrive (probably not live) transplanted into a new kind of mould, particularly a poorer kind

"If possible, the soil of the seed beds should be poorer than the soil of the garden—on no account richer. Taking care it is of the same nature as the garden soil, choose the poorest you can find The principle is well known in England, and it applies equally in India. From poor to rich soil plants thrive, but never the other way. For this reason, if you manure seed beds, do it very sparingly. Artificial shade for seed beds is a necessity; at least very many more seeds will germinate when it is given

"Natural shade over seed beds is *very* bad; for, *firstly,* the 'drippings' are highly in-

jurious; and, *secondly,* shade is only required till the plants are 2 or 3 inches high; after that *any* shade is bad, for plants brought up to the time of transplanting in shade are never hardy Seed beds, where water is handy, should not be dug deep If so dug, and the soil is consequently loose a long way down, the tap-root will descend quickly, and will be too long when transplanted. As water can be given when it is necessary, there is no need for the tap-root to go down low in search of moisture. A long tap-root is generally broken in 'lifting' the seedling from the bed

PATHS RAISED ABOVE THE SEED-BEDS.

"Seed beds raised, as is the usual custom, above the paths that run between them, are objectionable. They part with moisture too freely They should, on the contrary, be below the level of the paths, and, there is another advantage in this—for the said paths can then be used, partly as supports for the artificial shade and thus do away with the expense of long wooden stakes. As the seed beds are only required until the beginning of the following rains, there is no possibility of their suffering

from excessive moisture. When they are required to remain later, of course this plan of making the beds lower than the paths will not do

"Seed is best sown in drills, *six inches* apart, and each seed two, or if space can be got, even *three inches* from its neighbour. This facilitates each seedling being taken up later, with more or less of a ball of earth round the roots An all-important point. The length of the beds does not signify, but the breadth must not be more than five feet, so that a man on the path on either side can reach to the middle while hand-weeding or opening the soil. After what has been said no lengthy directions for making the beds are necessary.

"Cut down, burn or carry off all jungle, and then take out all roots, whether grass or other. Now make the surface level After this mark off the beds and paths, the latter one foot broad only, with string and pegs Then raise the path six inches above the spots marked off for the beds. This latter must not be done by earth from the beds, but by earth from outside the intended nursery. Next dig and

pulverize the soil of the beds to a depth of six or seven inches, no more, and level the surface.

"All is now ready for the seed. A string, five feet long, with a small peg at either end, is given to two men who stand on the path at either side of the bed. Each man has a six-inch measure. The string is laid across the bed, beginning at one end and pegged down at either side A drill is then made along the string about one inch deep, and this done the string is, by means of the six-inch measure on either side removed and pegged down again in the place for the next drill Seeds are then sown or placed along the first drill made, two to three inches apart, and the earth filled in This is repeated again and again till the whole bed is sown. If the character of the seed is doubtful, it must be laid in thicker, but with good seed two and a half to three inches is the best distance.

"The sowing finished the artificial shade has to be given Along the paths, at five feet apart, put in forked stakes two feet long, viz., six inches into the path and eighteen inches above it. Connect these with one another by

poles laid in the forks; now lay other, but thinner poles attached to the first poles at either end *across* and above the bed; and again these latter, that is, along *the length* of the beds, split bamboos, and then bind the whole frame-work here and there. The said frame-work will then be two feet above the beds, viz, eighteen inches of stake support and the six-inch raised paths The eighteen inches of opening all round, under the frame, that is, between the frame and the path, allows the necessary air to circulate; while the expense, danger from high winds, and the objectionable entrance of the sun at the sides, all of which high artificial shade is subject to, are avoided by this low frame-work.

"Mats are the best to cover the frame-work. In case of accidental or incendiary fire, they are not so objectionable as grass, for they burn less and slower, but mats are expensive Any coarse grass (free from seed) will answer, and it should be laid on as thin as will suffice to give shade The beds may be watered, if there is no rain, a fortnight after the seed is sown, and from time to time during

the dry season, whenever the soil at a depth of three or four inches shows no moisture The soil should also be kept free of weeds, and after the plants are three or four inches high, the spaces between the drills should be slightly stirred every now and then

"After the seed has germinated, and the seedlings have, say four leaves on them, the artificial shade should be taken away. But it must be done gradually, taking off portions of the grass first, so that the young seedlings may by degrees be inured to the hot sun. Though cultivation, as described, by watering and opening the soil at times is well, these should not be done much, or the seedlings will be too large when the time comes to transplant them. Large seedlings do not, as a rule, thrive as well as moderate-sized ones, after being transplanted.

"Among the many very absurd mistakes made in the cultivation of Tea, none exceeds the ridiculous way Tea seed used to be sown in the Government plantations in the North-Western Himalayas The seed was sown in drills, as I have advised, but in six linear

inches of the drills, where it is right to put two or at most three seeds, perhaps thirty were placed! I do not exaggerate; the drill, six inches deep, was filled with them Many and many lacs of seeds, in those days worth many thousand rupees, were thus sacrificed. Private planters in the Himalayas, taught by the Government method, once did the same. I believe the absurd practice is exploded now. Seed cannot be sown too soon after being picked It is ripe early in November, so the beds should be all ready by November, and if the seed has not far to come, it can thus be sown early that month "‡

SOWING IN SITU OR AT STAKE

"It is named at stake," explains Money, "because stakes are put along in lines to show where the Tea trees are to be, and the seed is sown at these spots The *modus operandi* is very simple A month before the sowing time (which should be as soon as you can get the seed), at each stake dig a hole at least 9 inches diameter and 12 inches deep, put the soil taken out on the sides, taking care, however, if it be

‡ Money's *Cultivation and Manufacture of Tea*, pp 61—65.

cend in search of moisture and the lateral rootlets can spread likewise. They (the latter) will not reach the outer walls of the pit for six months, and will then be strong enough to force their way through.

"Now sow the seed; put in, say, two or three, as the seed is good or bad, six inches apart Push them into the soft soil one inch, and put up the stake in the centre to mark the spot. Keep the place clean till the following rains, but allow only hand-weeding near the young seedlings, and occasionally open the soil with some light hand instrument as 'a koorpee' to the depth of half an inch. If all the seeds germinate and the seedlings escape crickets, and all live, at the commencement of the rains leave the best and transplant the others to any vacant spot. You will succeed with some, not with others; but do not be too anxious to take up the spare ones with earth round the roots and thus endanger the one plant left. That the seedling left be not injured is the *great* point, the others must take their chance.

"Some people believe in two or even three seedlings together, and would thus advise

them to be all, or perhaps two, left * I do not approve of the plan, except, perhaps with Chinese plants Plant as close as you will in the lines, but give each plant its own home. There is another mode of planting at stake which is, I think, better than the above

"Lay the seed in alternate layers of seed and mould in beds The seeds may be laid *close* to each other, but not *above* each other, with mould, say two inches thick, above, and then seed again When they begin to burst, ready to shoot out their roots, examine the seeds, by taking off the soil from each layer, every three or four days. Take out those that *have* burst, and plant with the eye or root side of the seed downwards Put all that have not burst back again Repeat the operation again and again every second or third day. Be careful, and take them up before the root projects —that is, directly the coating has cracked. By this means only one seed need be put at each stake, for it is certain to germinate, and seed

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* This sentence is quoted *exactly according to text*, but obviously contains some printer's errors as its latter portion is meaningless In other portions of this book, similar errors have crept in.

may thus be made to go much further. Great care is, however, necessary in this operation."*

PLANTING DISTANCE.

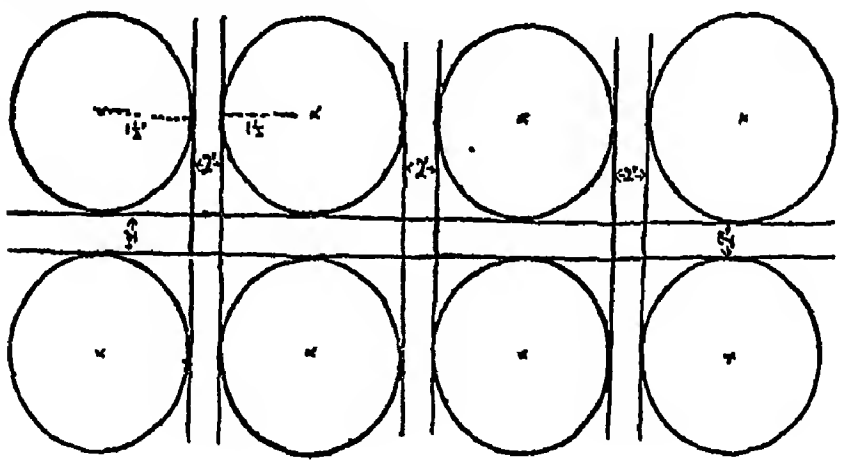
While seeds have to be sown closely in nurseries, as already described, they have to be sown 'in situ' or 'at stake' far more widely. In the latter case, it must be remembered that the seeds are put into their permanent sites in the plantation where they will finally grow to full-sized plants. Consequently more room around them is necessary. In transplanting seedlings from the nursery to the plantation, the same planting distance is kept as in sowing 'in situ' or 'at stake.' Gardens are sown at various distances, usually leaving spaces of 3 feet to 6 feet between each plant and each row of plants, which in the plains at least should be at right angles to each other. These distances are described as $3' \times 3\frac{1}{2}'$, $3' \times 4'$, $4' \times 4'$, $4' \times 5'$, $4' \times 6'$, etc.

In the processes of cultivation (hoeing, weeding, manuring, pruning, plucking, etc.) enough room is required around each mature plant for air to circulate in, sunshine to pass

* Money's *Cultivation and Manufacture of Tea*, pp 58—60

through and coolies to move about in freely. Then it must not be forgotten that Hybrids grow to larger sizes than Chinas and require more room Close planting is adopted where a large yield per acre, small cost of weeding or the economy of space is sought. Such short-sighted economy, however, may result in the ill-effects of a congested plantation What seems to be the best planting distance is 5′ × 5′ between the stems of plants On the average the diameter of each bush of a full-grown plant is about 3 feet or 1½ feet all round the stem, so that by this plan only an open space of 2 feet is kept at right angles between each stem.

Some of these spaces may be utilized finally as regular pathways, but the plan may be illustrated as under:—



Again, room should be found along the roadsides for a few big trees to afford shade for the workers here and there in the plantation. A shady tree (not too spreading) to every two or three acres should be sufficient. The argument that a closely-packed garden grows less weeds, is cheaper to work and yields more to the acre than a widely-sown plantation does not seem very sound. Close planting may lead to economy of space and less cost of weeding, but these are inconsiderable when compared to the proper facilities required for the development and cultivation of the plants A congested garden is moreover prone to a virtual epidemic, if attacked by fungi, blight or insect pests which travel most readily from bush to bush.

Money gives the undernoted calculation for planting distances between the lines of tea plants:—

Distances in feet	Square Feet to each plant	Plants in each acre	Area in acres one lakh of seedlings will cover
3 ft × 3½ ft	10½ sq ft	4,148	24 Acres
3 ft × 4 ft	12 „ „	3,630	27½ „
4 ft × 4 ft	16 „ „	2,722	36¾ „
4 ft × 5 ft	20 „ „	2,178	45½ „
4 ft × 6 ft.	24 „ „	1,815	55 „

In sowing up a garden, first decide how much you will sow the 1st year and arrange accordingly for seed, time to begin, and so on. During the first year, never try to sow more than 100 acres. If sowing from a nursery, transplanting should begin with the rains in June and be finished as soon as possible during the early part of the south-west monsoon. Remember that the holes for seedlings should be about 15″ deep and 10″ in diameter. If planting 'at stake,' begin in October and finish in November. These directions are intended chiefly for India, although they may apply to countries having seasons similar in period and climate.

Prior to planting 'in situ' or 'at stake,' careful planters make sure that the seeds are, first brought to life so as to reduce the chances of failure in the propagation of seedlings This cautious step consists of bringing the seeds into life in a *germinating bed* Such a bed is made by clearing a plot of land and digging it up thoroughly to a depth of about 12″ The bed is then levelled and covered over with some 6″ of fresh manure over which is

spread a layer of light well-pulverised soil about 4″ thick. The seeds are finally sprinkled over this bed without any seed touching another. Over the seeds is put a thin covering (of about 2″) of sand or finely-sifted soil. The bed is then well watered in sunny weather every 2nd or 3rd day, in cloudy weather less frequently. In hill gardens, if the temperature is low, glass frames are placed over the bed to impart the necessary heat for germination. Here it may be noted that the finger-like shoot which first appears from a germinated seed is the *root* (and not the stem) which should be sown downwards.

CHAPTER VII.

SUBSEQUENT PROCESSES IN CULTIVATION.

TRANSPLANTING.

PLANTING seedlings from the nursery to the plantation is known as *transplanting*. The term is not used to signify any other process such as the transference of seeds from germinating beds to the plantation when sowing 'in situ' or 'at stake' Transplanting refers merely to propagated seedlings and the above-defined process Planters, to effect drastic economy, may eliminate a germinating bed and sow ungerminated seed direct from the store-house to the garden, but thereby they would take the risk of many seeds failing to germinate This would augment the number of vacancies in a sown garden and entail the labour of re-sowing seeds or of finally resorting to the nursery and transplanting seedlings.

Short-cut methods are seldom successful when sowing up a garden so that much labour and attention are essential at the outset in tea

cultivation. Many seeds fail to germinate and some seedlings fail to live after being transplanted Hence to minimise failures, a germinating bed, or, better still a nursery is virtually indispensable. To provide against contigencies, planters ought to have from the very beginning about 50 per cent more seed than is actually used in a germinating bed or sown in a nursery Claud Bald shows how far a maund of seed will go initially, if sown in rectangular lines, on the undernoted plans :—†

Planting Distances	Plants per Acre	Area covered per Maund of Seed
4ft. × 4ft	2,722	3½ Acres.
4ft × 4½ft	2,420	4 „
4ft × 5ft	2,178	4½ „
5ft × 5ft	1,742	5¼ „
6ft × 6ft	1,210	8 „

The aforesaid table pre-supposes success both in the nursery and in the plantation, but as such optimism is unwarranted by experience, about 50 per cent. more seed should be held as a stand-by.

†Bald's *Indian Tea*, Calcutta, 1903 p 58

Transplanting has to be a very careful process, for if seedlings are badly handled in this process, they seldom survive the great shock of change in their embryonic position and environment. When the industry was young, this process was done entirely by *hand*; but in recent times, a 'transplanter' (an apparatus to facilitate the process) is being utilized If *mature* seedlings (with many lateral rootlets) have to be transferred, this instrument is unsuitable, however. But of course only *young* seedlings are transplanted Occasionally a young tea plant may be shifted from its place of birth, for some reason or other; but such change of habitat could hardly be described as 'transplanting' in the sense in which this term is used generally Usually seedlings (infant plants), 7 to 8 months' old, are transplanted from the nursery to the plantation—somewhat like the process in rice cultivation

The hand process seems more thorough than the mechanical process though the latter saves some labour of digging out from the nursery and affords some facility of convey-

PLATE 9—Transplanting seedlings from a tea seed Nursery

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ing to the plantation Anyway, if gravel or stone is mixed with the soil in the nursery, the ordinary instrument, known as the 'transplanter,' could not operate very readily Prior to transplanting, the nursery soil should be moistened by the early south-west monsoon to permit of easy digging If the rain is inadequate throughout the period of transplanting, it may be supplemented by the regular source of water in the estate—just to moisten the earth sufficiently to a depth of about 18". In the hills (Eastern Himalayas), spring showers may enable one to begin the process, but it is wiser to start with the regular monsoon especially in the plains.

For transplanting, too much rain is undesirable as it makes the soil too clayey Good rain at night with sunny or cloudy weather in the day would be ideal In operating *by hand,* a circular trench (about a foot in diameter and 18" deep) should be dug all round the seedling Then a garden fork (not a spade which would cut into the rootlets) is worked repeatedly into the trench so as to sever the soil all around the seedling which is finally

uplifted with more or less of a ball of earth round all its roots Care should be taken that the soil upon which the roots have been feeding is not disturbed. This earth is then made into a ball round the base of the seedling. If the soil is stiff, it should not be pressed too tightly which would strangle the rootlets.

The ball is next wrapped with green leaves and tied up lightly. It is then carried in a box or basket in an upright position to its prepared hole in the plantation Coolies, accustomed to rice transplanting, are inclined to operate in the rough manner used in this crop. They are likely to pull out the seedlings from the soft soil and carry them with little or no earth round the roots for good distances to the plantation Such treatment would kill outright any tea seedling as the tap-root would get lacerated and the lateral roots torn out. Hence, such coolies should not be employed for this process.

When sowing into the hole 'in situ' or 'at stake,' great care must be exercised. The seedling should be placed so that the tap-root must not be bent or doubled up and the collar

remain on a level with the surface of the soil around; in fact, the seedling should remain at the same depth in the plantation as it was in the nursery. If it has been well uprooted from the nursery, without any disturbance in the position of the roots, it will be well and truly laid in its new habitat.

Money describes this all-important process more elaborately. "On the day you intend to take up the seedlings from any bed," he explains, "if you have water enough at command, *flood the bed*. This, as you take up each seedling, will cause the soil, being moist, to adhere better to the roots. The difference between young plants transplanted with a ball of earth round the roots and those moved with their roots bare, is no less than a delay of three months in growth, if it does not even mean the death of the seedling. To prevent such mishaps, use a five or six pronged *fork* (and not a spade which might cut the rootlets) to *dig out* the young plants

"Then, with the hand take up each seedling separately, helping the soil with a very light pressure (so light that it shall not change

the lateral direction of any of the rootlets) to adhere and place it in a low basket sloping. Do this again and again till two baskets are full, when they will be carried, banghy fashion, to the garden. * * * There they should be put into the holes previously dug where the stakes were placed, most carefully. The manner in which this is done is of great consequence. Four things are all-important: (1) that the tap-root shall not be turned up at the end because the hole is too shallow, (2) that any rootlets projecting outside the attached earth shall be laid in the hole and shall preserve, when the soil is filled in, their lateral direction; (3) that the collar of the plant (the spot where the stem entered the earth in the nursery) shall be, when the pit is filled up, about 1½ inch higher than the surface of the surrounding earth; and (4) that in filling in the hole, the soil is pressed down enough to make it unlikely to sink later but not enough to 'cake' the mould.

"The following is the consequence of failure in these four points:—(1) Probable death, in any case, very much retarded

growth; * * * digging them up later, the tap-root was found to have gone down after all by assuming the shape of the letter S. (2) Rootlets turned away from their lateral direction interfere with other rootlets. * * * (3) Fill in as you may (unless you 'cake' the soil which induces worse evils), the plant sinks a little; thus, if not placed a little high, it will eventually be too deep If on the other hand placed too high, the rootlets and collar will be exposed which is an evil. (4) Unless this is attended to, the plant will sink too much and the collar be buried, likewise an evil, which it takes the young seedling some time to recover "‡

Money is of opinion, which we also hold, that days with heavy rain are not good to transplant in, but those with showers or light drizzles are the best. In case of a sunny break in the weather, he advises the stoppage of transplanting after the second day "for early rain to young transplants is a necessity." This writer also speaks of the 'transplanter' which had already appeared on the scene even

‡ Money's *Cultivation and Manufacture of Tea, pp* 76-77

in his time. He describes it as an apparatus with which this work may be done without the slightest injury to the seedlings which may be carried from nursery to plantation in another instrument called the 'transporter.' On this point, we are compelled to hold a slightly different opinion, as already expressed

Some days after transplanting, it is found occasionally that a seedling has shed all its leaves and only its bare stalk remains This is very remarkable as the tea plant is an evergreen and retains its leaves even in the winter The explanation of this phenomenon seems to be that the seedling has received a severe shock by transplanting and is unable for a time to support evaporation from the leaves which drop off in consequence. In the meanwhile the roots try strenuously to lay hold of the new soil and puts out feelers in every direction from its feeble sense of self-preservation. Unfortunately this instinct is not so pronounced as in the animal kingdom and apparently Nature helps it back to life

After a short struggle for existence, young leaf buds appear on the stalk of the

plant at the axils When writers speak of 'the sap being down' of the tea plant in the winter, they are not strictly accurate. The plant being an evergreen, the leaves continue to absorb gases from the air. There must consequently be an ascent and descent of sap, however feeble, between the crown and the roots of the plant

MANURING—OLD AND NEW.

At the present day, agricultural chemistry demands proper analyses of soils as well as of the ashes of plants to ascertain if manuring is necessary in any kind or stage of cultivation, and, if so needed, what the chemical constituents of manures ought to be In former times, seldom were such analyses made, but the tea planter instinctively gauged when fertilizing was required and applied the cheap and available cattle-manure which served his purpose apparently in ordinary practice. This subject will be presently discussed scientifically, but in the meanwhile let us see what was done in the olden days in this industry.

Money describes how "in a garden at Chittagong with poor and sandy soil, *manur-*

ing greatly increased the quality and outturn of tea; flush succeeded flush in less than a week while 8 to 10 maunds (640 to 800 lbs) was the yearly yield per acre" Likewise old planters urge that fresh *cattle-dung* is among the cheapest manures in India. It may be obtained in Northern Bengal at about 3 as per maund. Moreover, in this connection, the value of *garden refuse* (such as weeds and prunings of bushes) cannot be under-estimated If these are buried while they are fresh and green, their manurial value could not be ignored. In fact, dung and refuse are the commonest manures in tea gardens to this day.

Manure must be applied not close to the stem but about a foot from it where lie the rootlets by which the plant feeds. "Dig a round trench," advises Money, "with a *kodali* about 9″ wide and 6″ deep about a foot from the stem, lay in the manure and replace the soil at top. If the plants are young, the trench should be narrower, shallower and 6″ instead of 1 foot from the stems. The older the plant, the further are the rootlets from the stem.

As to the amount of cattle manure—for plants four years old and upwards, 1 maund to 20 trees is a moderate dose, 1 maund to 15 a good dose and 1 maund to 10 trees a very liberal amount Say, each acre contains about 2,500 plants (4 ft. by 4 ft.—a usual distance—gives 2,722 plants)." According to Money, 1 maund to 15 plants would require about 166 mds which at 3 as per maund would cost Rs. 31

Against this cost of manure, Money shows that the extra yield of tea per acre would be about 2 maunds, worth some Rs. 100. Agrain, to cost of manure, he adds Rs 7 per acre for *labour* of manuring, i.e , Rs 38 per acre as the total cost of fertilizing Consequently he estimates a net profit of about Rs. 62 per acre by manuring Of course, this estimate would scarcely apply to present-day conditions, which are somewhat different. Still it serves to show that it pays to manure occasionally. But fertilizers need not be resorted to until the plants come to maturity after about five years provided the soil in the meanwhile has got exhausted

MODERN IDEAS ON MANURING.

Early in this century the fundamental principles of manuring were lucidly exposed by Mr Georges Ville, then leader of the French school of agricultural chemistry, and by Sir William Crookes, the eminent British chemist Ville gave the analyses of various kinds of soil and species of plant, also discoursed largely on their chemical composition and the methods of restoring fertility in land for different crops. In propounding the basis of agricultural chemistry these authorities wrote as follows: "Chemical analysis shows that about 14 elements enter into the composition of all kinds of plants; they are divided into organic and inorganic elements, the former being carbon, hydrogen, oxygen, nitrogen, and the latter phosphorus, sulphur, chlorine, silicon, iron, manganese (?), calcium, magnesium, sodium and potassium."*

Originally in chemistry, there were naturally some vague conceptions regarding these so-called 'organic' and 'inorganic' elements.

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* *Artificial Manures by* Ville, translated and edited by Sir William Crookes, London, 1909, p 4

In the last century, carbon, hydrogen, oxygen and nitrogen were regarded as organic elements because they were believed to be the products of some 'vital force.' But since many so-called organic substances have been made artificially from inorganic materials, the distinction between organic and inorganic elements has begun to disappear. Moreover, since almost all the important groups of chemical substances found in plants and animals have been manufactured in the laboratory without the aid of living matter, the astonishing conclusion is inevitable that both the chemical substances and the chemical processes of living Nature are of the same general character as those in the non-living or inorganic world.

Since the days of Ville, the system of manuring has made little progress, as may be gathered from the writings of subsequent agricultural chemists "If a plant is burnt," says Dr. W Griffiths, "the organic constituents pass away in the form of gases due to their oxidation and the ash that remains consists of the mineral or inorganic constituents which the plant derived from the soil" He explains

that the fertility of a soil depends principally upon the presence of organic and inorganic elements "According to the *law of minimum,*" says Griffiths, "a soil destitute of any one of these mineral ingredients may become more or less barren, since it is the minimum of any one essential ingredient and not the maximum of others, which is the measure of fertility."

Then, a vital point is not what the soil contains but what is *available* for the plant "A soil may contain," he continues, "an abundance of potash, lime, phosphoric acid, iron, etc and yet be almost barren if these substances exist as insoluble compounds All the ingredients found in the ashes of plants must be present in a soil and in such a form that they are capable of being absorbed by the roots."*

Speaking on the methods of ascertaining the chemical nature of soils, Aide and Wood refer to the defect in one of the methods thus: "In making an analysis of a soil, we may go

* *A Treatise on Manures* by Griffiths, London and New York, pp 3, 13 & 15

to work from either of two points of view—(1) to find out how great a store of plant food substances the soil contains, in which case we require to find the total percentages of lime, potash, phosphoric acid and nitrogen present; and (2) to find out the amounts of each of these substances *available* for plant food at the time of taking the sample. This is a much more difficult matter than to determine the total quantities, for we are not as yet completely informed of the manner in which plant food substances are dissolved out of the soil for absorption by the roots"†

Wrightson and Newsham are more destructive in their criticism of the existing system of soil analysis. "There can be no doubt," they affirm, "that a soil may be rich according to analysis and unproductive in practice, and the reverse is equally true * * * Fertility depends upon such a large number of circumstances, above, below, around and in the soil, that a mere chemical analysis is insufficient."*

† *Agricultural Chemistry* by Adie & Wood, London, Trubner, Vol II pp 16 & 17

* Agriculture, Theoretical & Practical by Wrightson & Newsham London, Lockwood, 1921, p 13

Equally incomplete is the plant analysis because it reveals nothing of the organic matter that was in the portion of the plant burned and analysed This matter, which has passed out of the ash, went to form, along with the inorganic matter, important substances such as proteins (albuminoids), carbohydrates and cellulose Carbohydrates include the sugars and starches found in the roots and seeds of plants Cellulose goes to form the cell-walls and fibrous portions of plants Then, the protoplasm (the so-called 'seat of plant life'), after removal of water, contains meleo-protein 40 per cent, carbohydrates and fats 24 per cent and other proteins 15 per cent About 16 per cent. of the proteins consists of nitrogen In fact from the present methods of analysis, it is found that nitrogen, phosphorus and potash are more essential to plant food than the other constituents

In regard to soil analysis, the recent pronouncement of an agricultural chemist is not more encouraging "It is generally admitted now," says Corrie, "that the actual chemical analysis of a soil really possesses much less

value in this direction than might naturally be assumed, and, with the possible exception of the lime content, one is only able to obtain limited information of value for practical purposes, although of course, if an analysis showed poverty in any essential constituent, there would be little question as to the need for supplying this to the soil. Chemical analysis of the soil may, however, be used for comparative purposes."‡

Effective fertilization, such as would procure in the long run a net result of economic gain, seems a very perplexing problem in agriculture. There is less faith in the efficacy of manuring at the present day than in former times. Agricultural chemists are now the first to admit that the processes so far adopted in the system of fertilization leave much room for improvement. Under the existing system, when a plant shows signs of poor growth or inadequate outturn, the defect is attributed to infertility of the soil, *i.e.*, to a meagreness of

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‡ *Manures & Manuring* by Corrie, London Chapman & Hall, 1927, pp 9 & 10

the elements in it that go to provide food for the plant

To ascertain the nature of the deficiency, the soil is analysed chemically and mechanically; and the plant is also examined by a chemical analysis of the ash obtained by burning portions taken from the tree. Next, these analyses are compared with the approximate standards which usually exist of what the constituents should be in either case and the defect is sought to be remedied by the application of suitable manures to the soil. The ash analysis is not of such value as the soil analysis, but it serves at least the purpose of roughly checking the accuracy of the other, both being obtained from similar chemical sources. In the system itself, there are, however, some shortcomings

Until an improved system of plant analysis is devised, manuring will continue to be more or less a speculative treatment Nevertheless it must often be resorted to in old tea estates and in new ones very rarely Tea gardens are usually sown on forest lands which remain fertile for many years Speak-

ing of such soil, the eminent scientist, Sir E. J. Russell, observes: "Being the remains of previous generations of plants, it contains all substances necessary to the life of the plants, and, in addition, material synthesised by the plant during its life and still containing energy fixed by chlorophyll from the sun's rays. In the soil this energy material supports a multitude of micro-organisms." Sterility, fertility or exhaustion of the soil are relative terms, however, for a soil may be poor for one kind of crop and rich for another.

Even the present system of soil analysis is incomplete for another reason. Apart from the chemical composition of a soil, its physical properties and climatic surroundings are of no little value in determining its fertility It is for this reason that the dictum of Wrightson and Newsham, already quoted, does not seem too sweeping Physical properties chiefly consist in the nature of the soil—alluvial, sandy, clayey, etc—and the level at which water is usually present in it A plant largely depends upon finely divided soil particles for its food supply, without which even the aeration and

moistening of the upper stratum would be incomplete

In mechanical analysis, if some 30 per cent of the soil passes through a 90 mesh, about 30 per cent through a 60 mesh, some 6 per cent through a 30 mesh and about 34 per cent. consists of sand and small stones, the soil is said to be satisfactory. Anyway, good physical properties in the soil seem to be essential if all the chemical constituents in it are to be made *available* for the plant, but on this point our knowledge is still rather limited as suggested by Griffiths If the soil possesses good physical properties, we may proceed to analyse it chemically so as to ascertain what kind of manure it may require

After a comparison of the soil analysis with the plant analysis, the defects in the soil may be sought to be remedied by the application of artificial manures Where nitrogen is deficient, it may be supplied in the form of sulphate of ammonia, nitrate of soda, blood meal, groundnut cake, castor cake. etc. When phosphoric acid is wanting, it may be provided in the form of superphosphate, phosphate of

lime, basic slag, bone dust, etc. If potash is required, it may be added in the form of chloride, sulphate or nitrate of potash The Scientific Department of the Indian Tea Association has done much to increase the use of manures—such as cattle dung, oil-cakes, animal meals and artificials—but its earliest suggestions to the industry were in the line of *top-dressing*

Top-dressing means the admixture of new soil (usually the virgin soil of the nearest forest) with the old upper stratum It is a laborious and expensive process, but has proved very efficacious in refreshing old worn-out estates In case of two good soils of a different nature, a mixture of the two is likely to give better results than either of them singly. Varieties of soil are due essentially to the decomposition of different geological strata. A stiff soil is often benefited by the admixture of sandy soil or even of pure sand, while a sandy soil is rendered more beneficial by a mixture with it of a soil of closer texture The great problem for many tea gardens is how

to resuscitate exhausted lands or to replenish soils actually washed down the hill-sides

HOEING AND WEEDING.

After a tea garden is sown, the young plants need careful culture. The soil over the roots must be stirred to let in the air and weeds which crop up, especially in the rains, all around the plants must be uprooted These processes are known as 'hoeing' and 'weeding' They are undertaken chiefly in the autumn, but some hoeing and weeding may have to be done at other times. The hoe or *kodali* is, however, objectionable for the former process as it cuts into the soil and often injures the roots by scraping them or clipping them off altogether. Instead of the hoe, the fork is better; but in gardens, with light sandy soil, small *kodalis* have to be used as the soil is too loose to be uplifted between the prongs of a fork

Weeds must be eradicated because they draw from the soil the sustenance that should be reserved for tea, also as they choke the growth of its bushes. Especially sun grass (*seroo* or *ulo khor*) grows so tall and persis-

tently that it obscures the tea bushes. If there is a large crop of weeds, you have a small yield of tea. The secret of keeping ahead of weeds is to destroy them when young and never allowing them to bear seed "To conclude shortly for hoeing and weeding," observes Money, "I recommend as follows: Dig the whole garden thrice in the year, *viz.* Spring, Rains and Autumn. Bury all weeds as you dig in trenches between the lines * * Cultivate the plants by digging round them once a month if possible" *

PRUNING.

Leaves of tea bushes are pruned, as already explained, to make them yield a large crop of leaves which is the valuable product of this plant Without this process, very little leaf would be produced. Pruning is done only in the cold weather when the plant is hibernating. Then its growth is not vigorous Pruning is also done to cause lateral growth If the plant were allowed to grow vertically, it would run more to branches and grow so tall that plucking would be inconvenient. Hence, a

* Money's *Cultivation and Manufacture of Tea*, p. 81.

tea bush is never allowed to exceed four feet in height and the wider it is, the better for its culture There are many theories regarding the proper pruning of tea bushes, but they serve no useful purpose, as scientific pruning cannot be done by garden coolies on a large scale

In pruning, mass treatment cannot be accorded with any precision to, say, 250,000 plants, the number in a 100 acre garden at 2,500 in each acre. When a gardener prunes his favourite fruit tree, he can exercise some art; but when lakhs of bushes have to be clipped during two months (between the middle of November and January) yearly, the operation must be a rough one perforce Light, medium or heavy pruning must, however, be indicated for sections of the garden, according to the age and condition of the bushes Sharp pruning knives should also be used, for blunt ones would wrench off rather than cut clean the twigs and branches

Pruning should begin when the plant has established itself after about 18 months of growth It may be light the first time (i.e. in

the 2nd year of age), medium in the next and heavy before leaf plucking is commenced Generally plucking is begun about five years after sowing. All prunings should be buried between the lines of plants before the leaves have withered

STAGES IN THIS CULTURE.

The plant comes to maturity after about the age of five years, but there is no fixed period for the unripe age Its average may be set down at five years—about 4 years in the hot plains and some 6 years in the cool hills Maturity may, however, be forced and a tea plant made to bear leaves for a crop at the age of four which is premature and resorted to by planters who cannot afford to wait longer for a return of investment Light pruning after the first year may not harm so much as regular leaf plucking after the third year.

Early maturity does not seem desirable as it probably stunts the development of the plant and reduces its sturdiness for life A tea bush may live and bear leaves for over half-a-century but its health must be considered. As to

the average life of a tea plant, nothing definite can yet be laid down The industry in India is only about 70 years old and many bushes, sown at its start, still live and bear crops This makes some old planters believe that the plant may live to a century. It is fairly certain, however, that from the age of ten to about forty, a tea plant yields her best crops

LEAF PICKING AND PLUCKING

Certain considerations are involved in the dual process of *selecting* the leaves to be taken from the bushes and the manner in which they should be plucked At the outset botany teaches the planter that the tea bush, like all other plants, breathes through its leaves and that when the plant begins to *flush,* the new leaves cannot be roughly, severely or improperly treated. This is often done by inexperienced pluckers especially if there is no supervision over them by overseers in the garden Then, there is the commercial consideration which dictates fine, medium or coarse plucking in different stages of the crop.

With the spring showers, the bushes begin to *flush.* Tender bright green leaves develop

gradually all over the bushes. The second flush is recognized as "the growth from the axil between a leaf and stalk of the first flush." Roughly speaking, there are between 12 to 15 flushes in the season of 7 months from about April to October, although after the second flush, it is impossible to distinguish the succeeding flushes—all pretentions in this direction notwithstanding In different regions, the number of these so-called 'flushes' varies owing to differences in climate, soil, pruning methods and degrees of cultivation. The many tea tracts of India (Assam, Darjeeling, the Dooars, the Terai, the Nilgiris, the Chittagong hills, Dehra Dun, Kangra Valley, etc.) are subject to these variations

Generally in the plains the season of flushing is longer than in the hills. In the warmer climate of south India flushing begins in March and ends in November with probably 18 flushes in the season The intervals between the flushes also vary from about 10 to 15 days, although the period between the 1st and 2nd flush is longer. The finest tea is obtained from the bud, the leaf next to it yields

tea that is not so fine and the leaves further away produce the coarser teas. In fine plucking, only the bud and one leaf are selected; in medium plucking, the bud and two leaves; and, in course plucking, the bud and three or more leaves are taken. The bud of a tea plant may be described botanically as the embryo of a new shoot

It is said that a succeeding flush does not represent new leaves in place of those plucked in the previous flush, about a fortnight or so ago, but that they are usually from different shoots altogether. Money asserts that "the replacement of the actual shoot taken is a whole month in developing. I have carefully watched this and I am sure I am right"* This controversial subject is not merely of academic interest It is necessary to understand flushing thoroughly before you can pluck properly, and so a clear exposition of it by Money is here subjoined

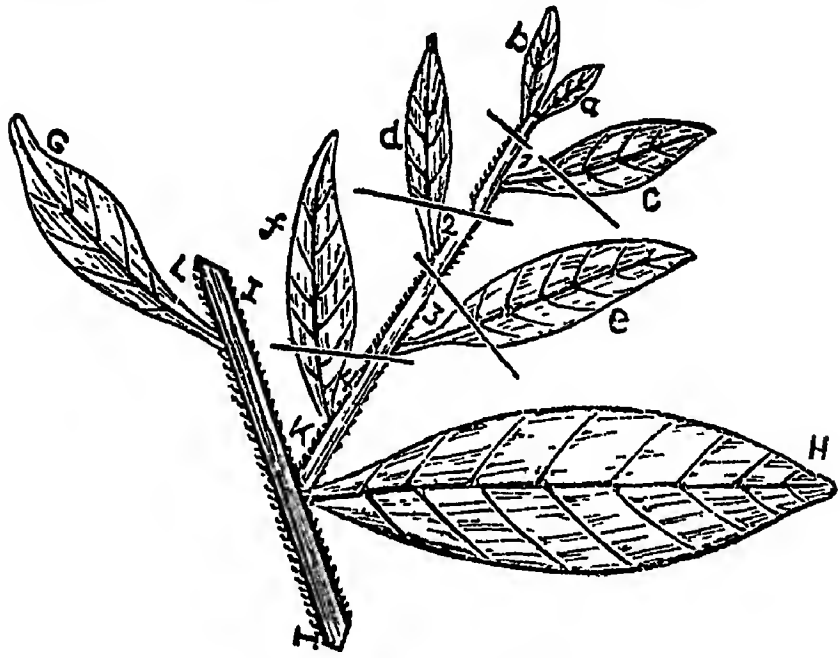
"The ordinary size of a good full-grown tea plant, at the end of the season, is, say, 3½ or 4 feet high and 5 feet in diameter. It is

* *Money's Cultivation and Manufacture of Tea*, p 99

pruned down, say, to a height of 2 feet with a diameter of 3 feet. It is then little more than wooden stems and branches, and to any one ignorant of the *modus operandi* in tea gardens, it would appear as if a plantation so pruned has been ruined. The tree remains so during all its hibernating period, that is, during the time it is resting and the sap is down (this period is longer or shorter, as the climate is a warm or cold one, and it is always during the coldest season), but on the return of spring new shoots start out from the woody stems and branches in the following way:—

"At the axil or base of each leaf is a bud, the germ of future branches, these develop little by little, until a new shoot is formed of, say, five or six leaves, with a closed bud at top Then, if it be not picked, the said bud at top hardens At the axil or base of each of the said five or six leaves are other buds, and the next step is for one, two or three of these to develop in the same way and form new shoots The original shoot grows thicker and higher until it becomes a wooden branch or stem. The same process, in their turn, is

repeated with the new shoots A diagram (see below) will make my meaning clear.*



Growth of Leaves and Buds.

"We here have a shoot fully developed, of six leaves, counting the closed leaf *a* at top as one, viz., the leaves *a, b, c, d, e* and *f*. *The shoot has started and developed from what was originally a bud at K, at the axil or base of the leaf H* In the same way as formerly at *K* a bud existed, which has now formed the complete shoot or flush *K a*, so at the base of the leaves *c, d, e, f*, exist buds 1, 2, 3, 4, from which later new shoots would spring. These [shoots] again would all have buds at the base

* There are two I's in Money's diagram but no J

of the leaves, destined to form further shoots, which again would be the parents of others, and so on to the end of the season or until the tree is pruned * * *

"The value of Tea is increased when it shows 'Pekoe tips' Only the leaves *a* and *b* make these. They are covered with a fine silky whitish down, and, if manufactured in a particular way, make literally white or very pale yellow Tea, which, mixed with ordinary black Tea, show as 'Pekoe tips' In ordinary leaf-picking these two leaves are taken with all the others, but unfortunately, when manufactured with them, they lose this white or pale yellow colour, and come out as black as all the other Tea As the season goes on, this is less and less the case, till towards the end nearly all the *a b* leaves show orange-coloured in the manufactured Tea * * *

"Tea can be made of the young succulent leaves only The younger and more succulent the leaf, the better Tea it makes. Thus, *a* will make more valuable Tea than *b*, *b* than *c*, and so on; *e* is the lowest leaf to make Tea from, for though a very coarse kind can be made

from *f*, it does not pay to take it. The stalk also makes good Tea, as far as it is really succulent, that is, down to the black line just above 2. The leaves are named as follows from the Teas, it is supposed, they would make:—

a...Flowery Pekoe
b...Orange Pekoe
c. .Pekoe
d . Souchong, 1st
e.. Do 2nd
f...Congou

a, b, c...Pekoe

Mixed together *a, b, c, d, e*...Pekoe Souchong.

"If there be another leaf below *f*, and it be taken, it is named, and would make Bohea. Each of these leaves was at first a flowery Pekoe leaf *a*, it then became *b*, then *c*, and so on That is to say, as the shoot developed, and a new flowery Pekoe leaf was born, each of the leaves below assumed the next lowest grade * * *

"Picking leaf is a coarse operation It is performed by 80 or 100 women and children together, and it is impossible to follow each and see that it is done the best way. They must be taught, checked and punished if they do

wrong, and then it will be done more or less right, but perfection is not attainable I advise the following plan in picking. Please refer to the diagram:—

"If the garden has been severely pruned (as it ought to be), take only the bud *a* for two flushes; then for two more nip the stalk above 1, taking the upper part of leaf *c*, as shown (done with one motion of the fingers). But from the fifth flush take off the shoot at the line above 2, and by a separate motion of the fingers take off the part of leaf *e*, where the black line is drawn

"By this plan, when the rains begin, the trees will show a large picking surface, for plenty of buds will have been preserved for new growth After the month of August, you make pick lower if you like, as you cannot hurt the trees For instance, you may nip the stalk and upper part of leaf *e* together, and separately the upper part of *f*. The principle of picking is to leave the bud at the axil of the leaf down to which you pick intact

"Some planters pick all through the season at the line above 1, and take the *d* and

perhaps the *e* leaf separately. I do not like the plan, for though it will make strong Teas, the yield will be small Moreover, the plants will form so much foliage; they will not flush well, and again they will grow so high that boys who pick will not readily reach the top.

"Shortly, the principle I advocate is to prune severely, so that the plant in self-defence must throw out many new shoots; to be sparing and tender with these until the violence done to the tree is in a measure, but not quite, repaired; then, till September, to pick so much that the wants of the plant in foliage are never quite attained; and after September to take all you can get I believe this principle (for the detailed directions given may be varied, as for instance when trees have *not* been heavily pruned) will give the largest yield of leaf, and will certainly not injure the plants"*

Many theories are advocated by writers and others with regard to plucking, but many of them are conclusions drawn from particular sets of conditions which cannot always be applied Hence these theories have little value

* *Money's C & M of Tea*, pp 101-106

and the planter must appeal to his own observation and experience. A few generalizations, however, have been made from sufficient data which may now be set forth. The number of leaves that should be picked with the topmost bud in fine, medium or coarse plucking (as already stated) constitute a sound conclusion which must be recognised as the general rule in plucking. This rule must be remembered along with what Money calls the principle of leaving intact the bud at the axil of the leaf down to which you pick *On no account can these lower buds be taken* as they will produce the new shoots for the next flush.

Another point to be remembered is that all bushes are not equally vigorous and their shoots are not all ready for plucking at the same time so that the picking from weak bushes may have to be delayed. Again, plucking off very young shoots even from strong bushes is not advisable. This is called *'close plucking'* and is done sometimes to get as much *fine tea* as is possible. When this plan is adopted, scarcely anything of new growth is left on the bushes, with the result that there

is a marked falling off in the quantity of leaves in subsequent flushes If this plan is adopted for any length of time, the early deprivation of leaves puts the plants on low diet habitually and so tends to weaken the bushes.

On the other hand, plucking as much as possible of mature shoots, even from vigorous bushes is not desirable. This is called '*hard plucking*' which taxes the bearing capacity of the plants to their utmost extent. Often this plan is purposely adopted to augment production and tide over financial difficulties. To avoid these adverse effects, only mature shoots should be plucked and what we call 'medium' plucking usually adopted Just as no farmer or fruit-grower would harvest his crop before or after it is mature, there is a proper time for the harvesting of tea leaves which may be discerned only by experience. But while other agriculturists keep no part of their crops behind, the tea planter must leave at least the reproducing portions (all the lower buds) on the plants, as he cultures a different sort of produce.

Weak bushes should also be treated with consideration. Experience will ultimately teach

the planter the proper time and method of harvesting his crop, a very important operation in this industry But in the meanwhile, he must *pluck only the strong or high shoots that are ready, leaving alone the new or weak growth for future picking.* To fulfil all these conditions, however, the manager or his first assistant must go round the garden every morning during the periods of harvesting and instruct the overseers (who supervise the work of women and boys engaged for plucking) as to the procedure that should be adopted for each flush.

When inexperienced coolies are employed for plucking, planters give the overseers a two-foot stick to measure the height above which plucking should take place This is merely a rule-of-thumb for the very thick-headed and may be dispensed with along with such workers. In former years plucking was even sought to be done by mechanical means with the aid of a clipping instrument, but such attempts led to no practical good and hand-plucking has proved to be the best and quickest mode Since only tender buds and succulent leaves are

taken, even a pair of scissors would be an unnecessary impediment Women are dextrous enough with their nailed fingers.

In this operation another point must be remembered As little stalk as possible should be taken. Stalky tea has scarcely any liquor or flavour. Again, a leaf should be plucked clean in its entirety instead of a portion of it being left behind with the stalk The leaf so cut by the finger nails is sure to ferment and become useless Whole leaves should be taken. These are small defects which should be avoided. Before the close of the season, a change in the mode of leaf selection may be made. After August very young shoots or even weak bushes may be plucked, but never before September.

If the bushes are healthy and not overtaxed, the *average production of leaf per acre* should be nearly 4 maunds in the hills and about 6 maunds in the plains Some of the Assam gardens, in their younger days, have yielded twice this quantity in the lower valleys. The yield per flush also varies, but this is largely a matter of the plan of plucking. Still another

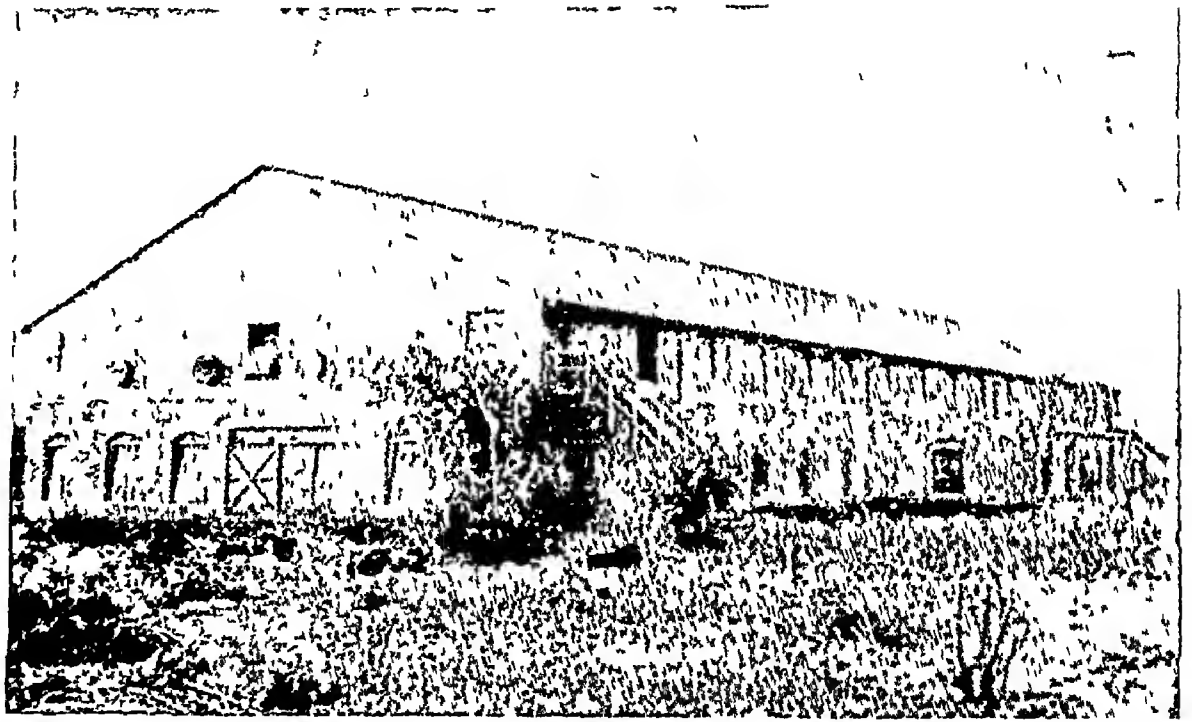


PLATE 13—Exterior of a tea factory showing four Sirocco Wall Fans at one end of the Withering Loft

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point to be remembered, while plucking is going on, is the prevention of leaf fermenting in the baskets and sometimes in the cloth bags used by the pickers The exposure of the baskets to the sun's rays or the use of a cloth-bag in which the leaves get no air are causes for this evil. A wicker-work basket, covered by a piece of cloth during sunshine, would avoid the contamination. This mode of fermenting is misplaced and renders the leaves quite useless. It is different from the regulated process of fermentation employed in tea manufacture

Leaves ferment in the baskets by frequent exposure to the sun, by being kept densely packed without any ventilation or sometimes by a sudden fall of rain over them. Such leaves are easily detected as they begin to assume a copper colour By this misplaced fermentation, they become more than useless as they tend to contaminate the fresh leaves and so should be thrown away without hesitation They could not possibly be kept aside and mixed up subsequently with the fermenting stock in the factory. It is true that in tea manufac-

ture, leaves are first withered then rolled and then fermented, but that is a somewhat different process of oxidation.

Directly a basket gets full of leaves, it should be taken to the factory for weighment. Before the work of weighing, the leaves should be examined to reject the fermenting ones, to see that no lower buds, not many stalks or coarse leaves have been picked The attention of the picker should be drawn to errors in these directions and the picker warned to prevent their repetition. The overseer has to see that there is no faulty picking, but plucked leaves cannot be admitted into the factory blindly.

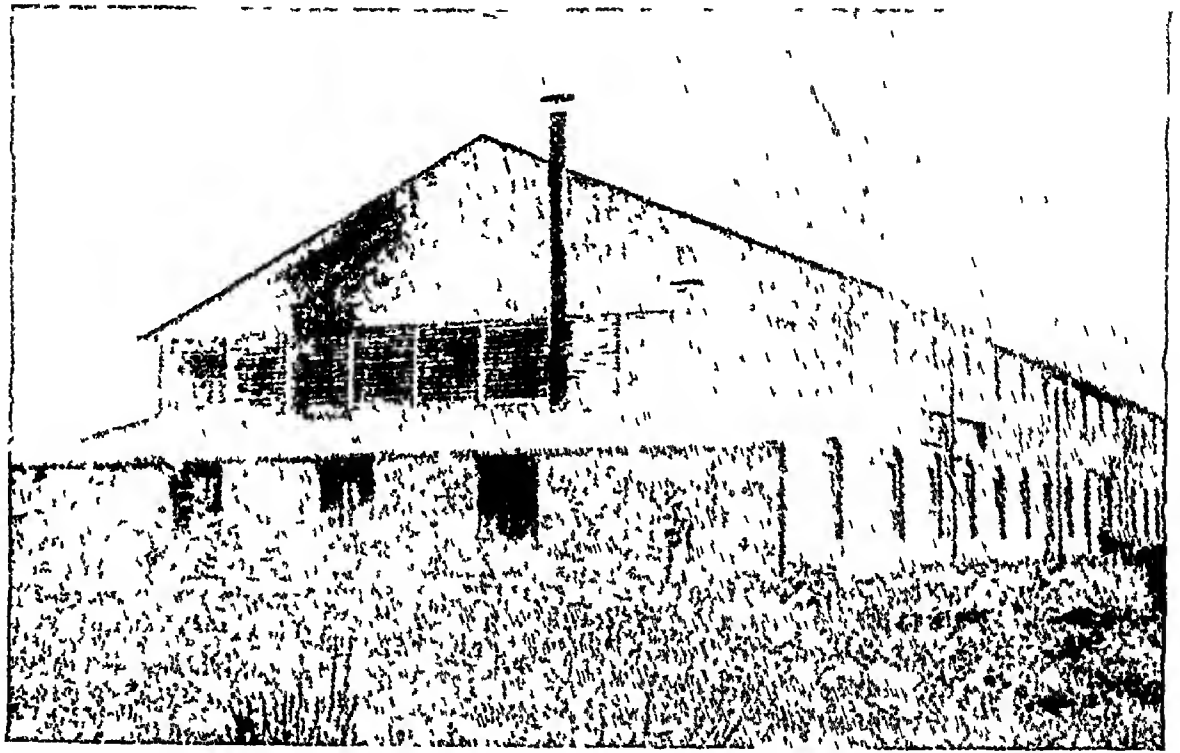

PLATE 14—Opposite end of the factory (depicted in Plate 13) showing louvres through which air enters the Withering Loft

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CHAPTER VIII.

THE MANUFACTURE OF TEA.

PROCESS OF WITHERING.

THE modern system of tea manufacture has evolved gradually from the crude hand processes (described early in this book) that were pursued for centuries in China and subsequently in some of the neighbouring countries of the Orient Not only is this system suitable for mass production, but, being based on scientific principles, it produces better, cleaner and larger varieties of tea to suit all tastes Such a development was inevitable when tea became a staple article of consumption for the entire globe. Often we are inclined to view only the dark side of a picture and decry the evils of the 'factory system,' but we ignore that, without its evolution, the products of the earth would not have become available for the convenience of all humanity.

Still we may continue the hand processes in their improved forms for certain industries —even for tea manufacture which needs

largely the aid of hand labour in places remote from the centres of this industry like the Near East and perhaps Central Asia. Thus we may delay the ruthlessness of 'the machine age' by less labour-saving devices, but we could not altogether abandon 'the factory system' in this and many other manufactures for it is the natural result of a progressive world as much as of the purposive creation of science. Since the 19th century the proper sphere of hand and small industry seems to have become limited to the procuring of the primary products of the earth by agriculture, forestry, mining, fishing and the like while large-scale manufacturing has to be done chiefly by the factory method.

Many processes in the tea factory yet require a lot of labour. *Withering* is one of them. It must begin as soon as possible after the leaf is brought in by the pickers. While leaf weighment is going on, the weighed leaf has to be spread thinly and evenly on the hessian or wired bottoms of the withering racks. These racks are placed in rows along the length of the withering shed or apartment.

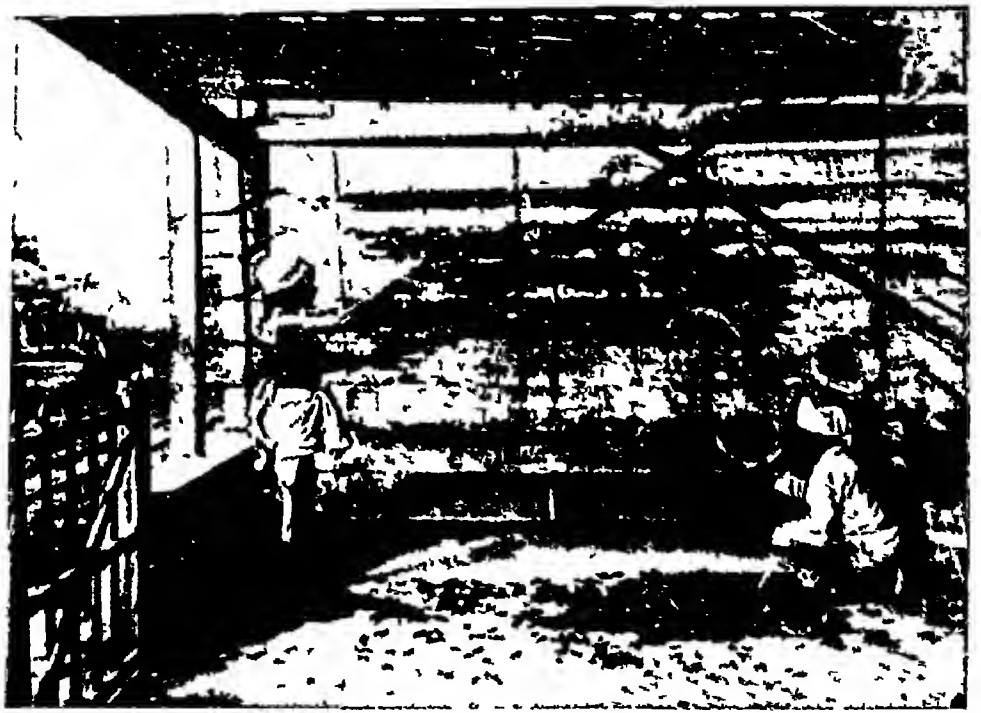

PLATE 15 —Interior of an old withering Shed

They are fixed, one above another at intervals of about a foot, in long rows, between which are corridors running along the length of the structure Formerly the withering shed used to be located outside the main factory premises to provide for sufficient ventilation But in very wet weather, the shed failed to dry the leaves satisfactorily (See Plates 15-16)

Now the withering is done on the *entire* middle or top floor of the factory building which is drier than the detached shed outside owing to the presence of the tea drying machines on the ground floor Besides, a lot of surplus space is required for withering when a big flush comes on . Then the leaves cannot wait to be withered for want of space in the apartment because then they would begin to undergo a mild form of putrefaction which would taint the quality of the tea ultimately. An entire loft of the main building is therefore required for this process. The main object of withering is to abstract about half the water that is in the green leaf without which the leaf could not stand the strain of the next process of rolling but would break

up under the rollers. In fact the leaf must be both physically and chemically prepared for the subsequent processes.

Scientists indicate that this preparation consists in drawing out the water from the leaves, making them soft and flaccid, also making them partially ready for the later process of fermentation which should not however begin until the leaves are withered and rolled Dr H H. Mann (the first Scientific Officer of the Indian Tea Association) is said to have pointed out that withering develops the natural enzyme or fermenting propensity which adds materially to the flavour and liquor of the prepared tea later on According to this authority the chemical and physical changes that take place in withering by natural means require about 18 hours Consequently, the inference is often drawn that if withering is done in a shorter time by mechanical aids, it is doubtful if at least the chemical changes are fully induced.

Owing to this doubt, little faith was at one time attached to withering machines which were designed to economize time and labour.

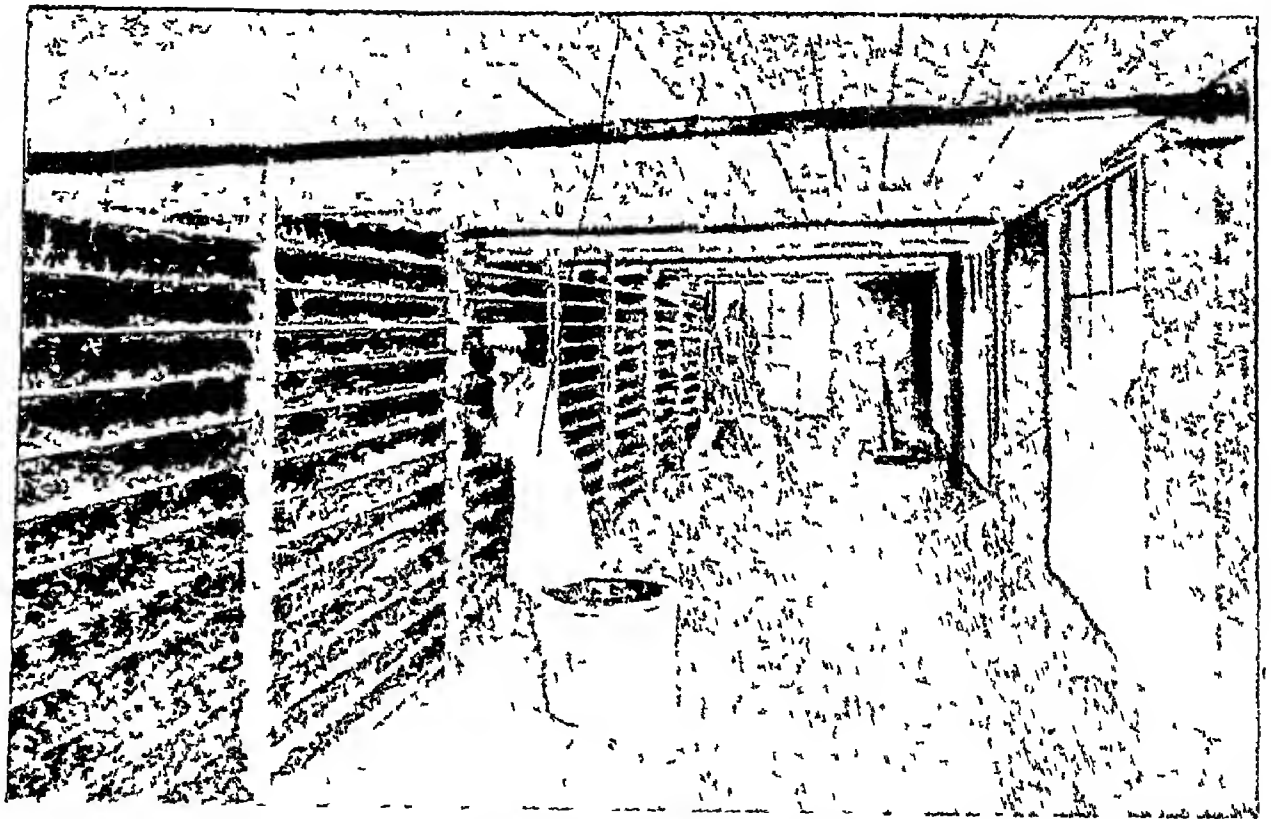

PLATE 16—Interior of a modern Withering Loft ventilated by power driven Fans

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Surely the whole thesis has to be further investigated, as it should not be impossible to hasten both the chemical and physical reactions by scientific methods, on an economical basis. As a matter of fact to-day the best withering —at least on the physical side—is being done with the aid of fans in the withering loft designed by Messrs. Davidson & Co. of Belfast, the makers of the renowned 'Sirocco' tea machines. This construction will presently be discussed. Still many planters are conservative or unwilling to go into the expense of an innovation Hence in the meanwhile, the slow and troublesome method of withering, by natural atmospheric agencies, is largely continued but the old detached shed outside the factory is seldom found anywhere

Generally the withering apartment is now located just above the ground floor of the factory which contains the drying machines. This loft being above a floor in parts of which high temperatures are created, too much heat is prevented from coming up by linings in the cealing over the driers. As in the old detached shed, the racks are placed in four rows along

the length of the loft and they slant a little lower on the passage side so as to facilitate the withdrawal of the withered leaves. The racks are made of oblong wooden frames which in former years enclosed a stout hessian cloth of open texture made specially for this purpose In recent years the tendency has been to replace the hessian cloth by wire netting.

The cloth absorbed some of the moisture from the leaves, but took it upon itself, and formed a damp bed, which in stagnant air, imparted an unpleasant smell to the leaves, if they were spread thickly on the cloth. Now the wire netting has come more into vogue, but the objection to it is that it is apt to mark the leaves if they are heated by the use of fire in the withering room. This seems a flimsy objection, as galvanized wiring would seldom do so Though this netting may be a little more expensive than hessian, it is, we think, cleaner, more durable and far more convenient.

After the leaves are weighed, they are spread without delay on the racks evenly and

thinly. There should always be enough of windows to ventilate thoroughly the withering apartment. Here the foremost need is *dry air*, while moist air from outside has to be kept out as far as possible Also, when the air inside gets damp and stagnant, it should be expelled. All this regulating of ventilation is hardly possible in wet weather when plucking takes place usually. Hence fire has often to be used to dry the air in the withering loft. Now it must be finally and definitely perceived that there is no alternative left but to adopt regularly this artificial drying if there is to be any improvement at all on the old method.

Especially hot air generated in the drying machines below must be utilized here and a current of cool, fresh air always passed through the loft by propelling or centrifugal fans. These are the objects now attained quite satisfactorily by the Sirocco Withering Loft illustrated in Plates 13 and 14. The makers explain their construction as follows: "One of the chief difficulties in natural withering of Tea Leaf is the change in climatic condition At night the atmosphere is often cold and

moisture laden, and the wither, when carried out under such conditions, is greatly prolonged owing to the leaf reviving to a certain extent. This, of course, causes serious delay to all the work in the factory and thereby increases the cost of production.

"We have devoted a great deal of attention to the question of withering, and after long and careful experiments have proved that by the use of Sirocco Centrifugal Fans, properly proportioned and correctly applied, the entire volume of air in the loft can be positively and evenly controlled, thereby enabling the temperature and saturation to be regulated and ensuring results equal to those obtained under the most favourable natural conditions Briefly summarized, the chief advantages of withering by mechanical means are the following· (1) Uniformity and regularity of wither; (2) saving of time and (3) increased capacity of withering lofts The entire air contents of the loft being under control, the flow of air over the leaf is the same at all parts, and an absolutely uniform wither is thus obtained at regular periods.

"The time taken must necessarily depend on the quality and condition of the leaf, the thickness of spread and the saturation and temperature of the air, but, under favourable conditions, a good cold limp wither can be obtained in six to ten hours In wet weather it may require from 12 to 16 hours, but even under the most unfavourable conditions, the whole of one day's plucking can be manufactured within 24 hours. With the Sirocco system of Fan withering it is also possible to increase the spreading surface by reducing the space between the tats or shelves, and as, in addition, the time occupied in withering is greatly reduced, the capacity of the lofts is considerably increased" Planters who have installed this system testify to the enormous benefits it has brought in its train, such as withering 300 maunds of green leaf daily.

THE OPERATION OF ROLLING

Before coming to this operation, it may be mentioned that sometimes leaf is purposely underwithered to retain a strong liquor for the tea, but such tea is likely to suffer in flavour. On the other hand, overwithering has the

opposite effect It seems to develop flavour at the expense of liquor These are inferences drawn from past experience. Also it is true that if you ask experienced planters what element in manufacture produces quality in tea, the variety of answers, you will get, will surprise you. Doubtless there is much room for research in this direction by tea scientists. The degree of leaf withering should depend primarily on the quality desired according to market requirements

Withered leaf should always be cooled, if the final exposure has been to warm air, before it is sent to the rolling tables At the same time there should be no unnecessary delay in sending down properly withered leaf to the rolling machines where it is crushed between their rotating metal plates. *This opens the cells and liberates the juice from the withered leaves* Again, the rolling room should invariably be located in a cool part of the factory. It should never be next to the engine room or close to the drying machines. Here it may be mentioned that the leaves are not pressed between rollers or cylinders in the

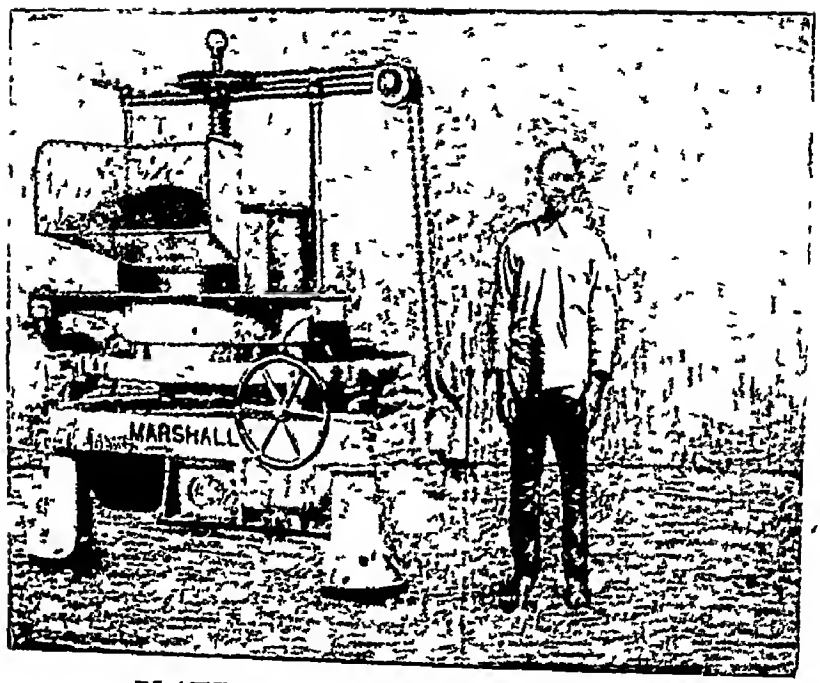

PLATE 17—Jackson's Rapid Tea Roller

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machines which are called 'rollers' merely to use a short name

In describing the main object of rolling, Mr. Claud Bald has put it very lucidly as follows: "The chief object of the process [illegible]ed as *rolling* is to burst the cells in which [illegible]uice of the leaf is stored; this has to be done by bruising or macerating the leaf without actually tearing it into shreds. The cells being burst open, the juice is liberated and flows over the surface of the leaf so that subsequently when dried, the water only being evaporated, the extractive matter remains on the surface ready to be dissolved at once, on the application of boiling water." * Incidental to the process of rolling is the *curling of the leaves* which is not essential to its proper chemical treatment, but the twist subsequently imparts a good appearance to the tea.

In the process of rolling, if the leaves do not curl, they may be recognized as too old and tough to produce good tea. These are technically known as 'red leaf' because they

* Bald's *Indian Tea*, Calcutta, 1903, p. 178

appear in the finished product as flat, flaky chips of a reddish tinge. Rolling has also been rightly spoken of, by the aforesaid authority, as leading to an incipient stage of fermentation. "During the process of rolling," remarks Bald, "as soon as the juice comes into contact with the oxygen of the atmosphere, it becomes more or less oxidised, and the chemical changes begin, which transform the crude sap into palatable tea, and at the same time the leaf begins gradually to change colour, so that when rolling is completed the mass of leaf is soaking wet with its own juice, and its bright green colour has already in it a tinge of copper."*

Though even incipient fermentation should be prevented in withering, there is apparently no harm done if it begins in a mild form after the rolling has taken place. If oxidation were to begin too early, the leaves would not be amenable to the rolling treatment which is necessary to produce the kind of tea desired by the human palate. This is a moot point, however, on which the scientists should

* *Ibid*, p. 179.

conduct further investigations Nor is this the only problem for tea scientific research. Another very important matter is how to prevent what is known as the ' stewing ' tendency of the prepared leaves in the Drying machines when heat over 150° Fahr. is applied to them. This tends to extract both liquor and flavour from them which is fatal to their quality. This matter will be discussed fully under the Drying Process

Researches in these directions are being conducted by the makers of Tea machinery while our tea scientists are still absorbed mainly on the agricultural side This is a sad commentary on their technological progress Anyway, we shall now revert to the operation of Rolling. In the olden days, hand-rolling was a very slow, erratic and laborious process It is fortunate that, after years of experiment, good rolling machines have been constructed which perform this operation far more satisfactorily and have contributed largely towards making tea a world product The original Jackson's patent Rapid Roller is now being built near Calcutta by Messrs. Marshall Sons

& Co (India) Ltd, and the local product is a marvel of mechanical skill. (See Plate 17).

The Sirocco O C. B Roller, made by Messrs Davidson & Co. Ltd., of Belfast, is also an excellent machine. (See Plate 18). Both these machines roll the leaf and express its juices without damage or tearing, thus preserving the appearance of tea by giving it a hard twist and good roll. Jackson's patent carries 'yong tong' scrapers which clear up the table at every revolution Davidson's patent adopts grease in place of oil for lubrication so that none of the lubricant can come in contact with the leaf. These devices ensure *cleanliness* which is an essential thing in turning out tea of good quality.

Planters may differ as to what other factors go to produce quality teas, but they are unanimous on this point The carriers of rolled and fermented leaves should be made of galvanized metal which can be cleaned thoroughly The 'rolling table barrow' and 'rung bowls' made by the Indian Galvanizing Co, Ltd (Balmer Lawrie & Co), for these purposes are recommended. Tea also takes up

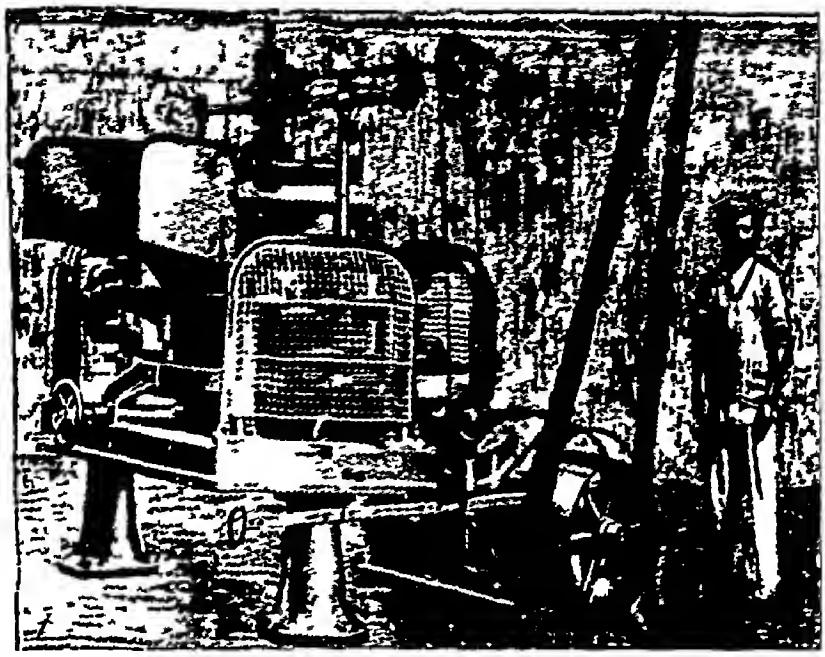

PLATE 18—Davidson's Sirocco O C B Tea Roller

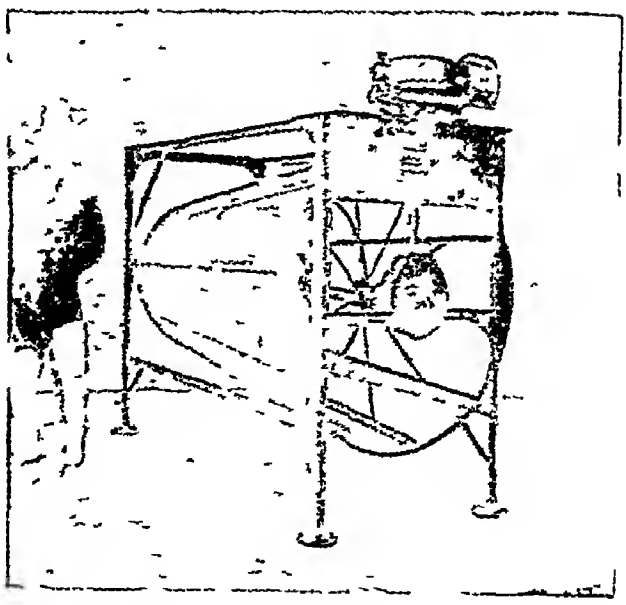

PLATE 19—Davidson's Tea Roll B-eaker

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bad smells very readily during manufacture, and so malodorous things, such as tar and paint, should never be stored near the factory, nor any oil-engine be worked near it.

Both the aforesaid Rollers have good capacities, each taking a charge of nearly 400 lbs. of leaf at a time But the rolling machine should never be crammed with leaf. It should be started before the leaf is put in and then fed gradually, meanwhile the speed of the roller slowly increased The worker of the machine should regulate very cautiously the 'pressure cap' on top so as to prevent balling and heating of the leaves. To safeguard against excessive pressure on the leaves, there is a safety spring attached to the pressure cap of the Sirocco Roller

After the *first light rolling* for nearly half an hour, it is customary to take out the leaves from the Roller to break up the balls that might have formed there as well as to sift the fine, medium and coarse leaves before subjecting at least the lower grades to a *second* course of *hard rolling* In the second operation, the juice flows freely and it is desirable that the

juice of the coarse leaves should *not* get mixed up with at least the fine leaves This would give them all an inferior flavour. Also, hard rolling darkens somewhat the bright colour of the fine leaves Separation is consequently necessary here since joint treatment would deteriorate the purity and quality of the finer leaves However, it should be mentioned that the procedure followed after the first rolling is not the same in every factory This depends partly upon the special needs and facilities of planters.

In former years the sifting of leaves was done by flat sieves working to and fro horizontally while the breaking of the balls was done by agitating arms But now a good breaking and sifting machine has been constructed by Messrs Davidson & Co which is known as their Roll Breaker (*See* Plate 19). This is a wire-meshed cylinder shaped like a cone. Placed horizontally, the cylinder revolves slowly. The leaf is fed from the small end of the cone and is separated into three different grades—coarse, medium and fine—while the balls are broken up by the action of the

machine. Moreover, the leaves are cooled and aerated so that eventually an even fermentation is assured in the next process Here also the practice that is adopted is not identical everywhere In rolling the same principles are followed, but the details of work vary according to circumstances.

THE PROCESS OF FERMENTATION.

Fermentation is a chemical process into which our scientific insight is still very superficial and in a rudimentary stage. The planter knows that rolled leaves, by contact with the air (oxygen), begin to get oxidized with the result that the leaves along with their juices undergo certain chemical changes which he discerns by alterations in their smell and colour. He also knows that this transition takes place generally between two to five hours in a warm climate and after many more hours in the hills. Hence he is guided by smell, colour and time to decide when the process is complete. During these changes in the fermenting mass, he would like to retain in it such properties as would yield a good flavour and a suitable liquor in the finished product, but so far he knows no

definite means of bringing about these desired results.

Being largely in the dark, the planter is helpless and thinks that no manipulation is required because it could do no good. He follows more or less a 'rule of thumb' with regard to time, smell and colour, and when he thinks that the proper stage of fermentation is reached, he stops it by sending the leaves to the drying machines. But chemists have done very little to enlighten him on this process. If during fermentation in the factory, they were to analyse chemically the leaves from time to time, they would doubtless be able to indicate to the planter the conditions under which the ethereal oil (the essence of flavour) could best be retained Moreover, they could ascertain if at any stage the theine (the stimulating and refreshing element) is being lost, and, if so, how to prevent it, also the means by which the tannin (the indigestive constituent) could be expelled as far as possible.

At the same time, chemists should be able to point out how best to retain the properties that would suit the needs of the market Doubt-

less some planters, by their keen observation and extensive experience, have an insight into these potentialities As a matter of fact, planters do taste their teas frequently, but this can be done at the earliest during the drying process when fermentation is finished. Probably chemists in the great scientific research stations at Passaroen and Buitenzorg in Java have already embarked on this line of investigation because Dutch growers seem bent upon becoming the most formidable rivals of Indian teas in the not distant future. Anyway, generally speaking, we are still much in the dark over this process in India. Surely this is rather a deplorable condition in the leading tea-making country in the world.

Mr Kelway Bamber—the well-known tropical botanist who was once a Curator of the Botanic Gardens at Peradinya in Ceylon—is said to have thrown some light on this process "Mr Bamber has discovered," relates Mr Claud Bald, "that the fermentation of tea leaf is due to the presence of an *enzyme* or vegetable ferment, which is quite distinct from organic fermentation, the latter involving the

presence of living organisms, which bring on a certain amount of decomposition and putrefaction If, however, the process of ordinary fermentation is unduly prolonged, this organic fermentation sets in and the leaf soon becomes sour."* Though this discovery appears to be of fundamental value, it does not seem to have been made use of by chemists to lead to any practical results in tea manufacture.

In the olden days, fermentation was done on the cemented floor because it was thought to be the coolest place in the factory. Since the floor absorbed the juices from the leaves and also could not be cleaned thoroughly, the floor was abandoned and the process was conducted for a time on tables covered with zinc plates. Later a cabinet containing a series of drawers, one above another, was devised It resembled a writing table the top of which stood about 4 feet high from the floor. The rolled leaves were placed in the drawers which had openings in them to allow of air to play on the leaves. (*See* Plate 20). In recent times some factories have begun to ferment in

* *Bald's Indian Tea,* P 185

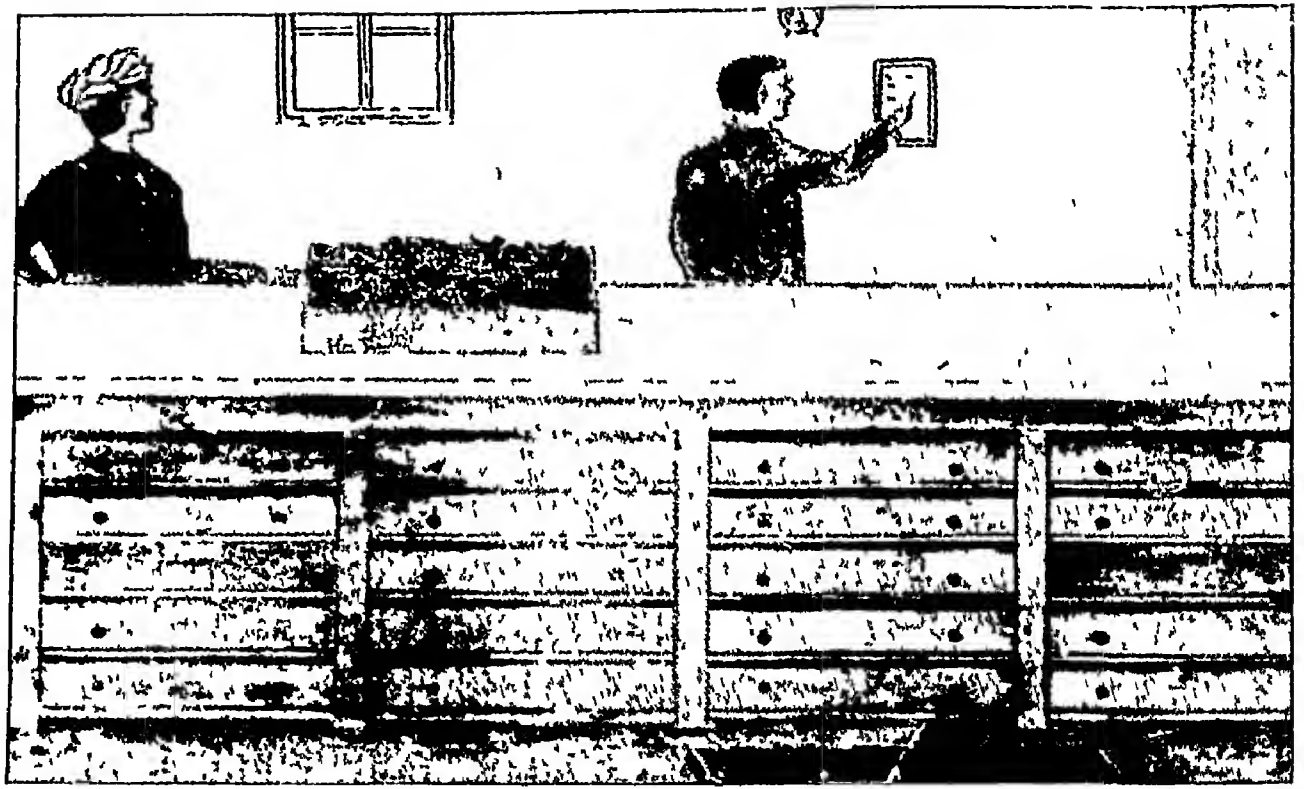

PLATE 20 — The later method of fermenting tea leaves in a cabinet with drawers which admit air from the slits in front and their meshed bottoms

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trays or shelves placed in a cabinet, resembling an almirah, with a fan working in front of it to ventilate the trays.

The rolled leaves are spread in the aforesaid drawers or shelves in layers of roughly three inches thick Fine leaves and the early flushes ferment readily and so are put in layers of some two inches in thickness But coarse leaves and the later flushes take longer to ferment and so are put in layers of some 4 inches in thickness This is done to induce the ferment by the warmth of the layer As a rule rapid fermentation indicates good quality of leaf while slow development may be taken as a sign of poor quality. The heat of the fermenting room should not be allowed to go up above 85° Fahr

During fermentation, the leaves change colour from a pale or dark green to a light or dark copper tinge But there is nothing positive about these fine shades which doubtless vary according to quality of leaf and degree of ferment. Small wonder that there is so much vagueness over this test. Again, the leaves at first emit the smell of raw vegetable, something

like that of cut cabbages, but the odour changes gradually to a smell like that of fruits This aroma is regarded as a surer sign of the desired stage of fermentation than the change of colour to a dark or brownish copper. Then, as to time, this is a more inconstant condition depending as it does on a larger number of circumstances—such as the quality of leaf, degree of rolling in the previous operation, mode of lay-out in this process, climatic variations, etc. All these are variable quantities about which more scientific precision will doubtless be attained in course of time by a deeper study of the chemistry of tea making.

THE OPERATION OF DRYING

If we consider the remarkable progress that modern methods of drying have brought to this industry, we could not possibly deplore the passing away of the old tedious, unhealthy and inefficient hand drying once practised in tea making Hand methods, as already observed, still possess much utility under particular circumstances, but they have become quite useless and obsolete at least in leaf-drying, the

advance in which has contributed most to the modernizing of tea manufacture. Even now wood, oil and coal fuel provide the drying heat and driving power used in most tea factories, but a time may come when these needs will be supplied more effectively by hydro-electricity—a far cleaner and less vexatious medium in many respects.

Tea making has been improved vastly by the introduction of drying machines which are now rather expensive, but their cost may be reduced substantially by being built in India. There is nothing wonderful about their construction Their main functions are to dry the fermented leaves by subjecting them to a constant and uniform heat, which may be controlled in cases of emergency; also, inside these dryers the leaves are turned over at regular intervals automatically. The regulated temperature—which is most essential—was subsequently secured by the addition of a mechanical stoker. Formerly the man who used to do the stoking often put coal into the furnace irregularly with the result that the temperature inside varied considerably.

There are cold-air inlets in the dryers which reduce the heat if they are opened, but these inlets are to be used only in emergency They are not meant to bring down the heat after it has been raised suddenly by an over-charge of coal because such a remedy would waste heat as well as coal unnecessarily. Uniform stoking was consequently the essential need, which has now been provided for Every drying machine has a thermograph on either side to register the heat where the leaves are being dried Also, in every machine there is a force fan to bring in the air and an exhaust fan to drive it out. In the drying chamber the leaves are regularly tilted from one tray to another and evenly spread on them. Mesh wire trays are used mostly These are the general principles adopted in mechanical drying, but all machines do not follow the same plan with regard to matters of detail.

The main objects of drying fermented leaves are: (1) to arrest fermentation, (2) to slowly dessicate them, (3) to drive out their moisture, and (4) to retain their tea characteristics. Great care should be taken that the

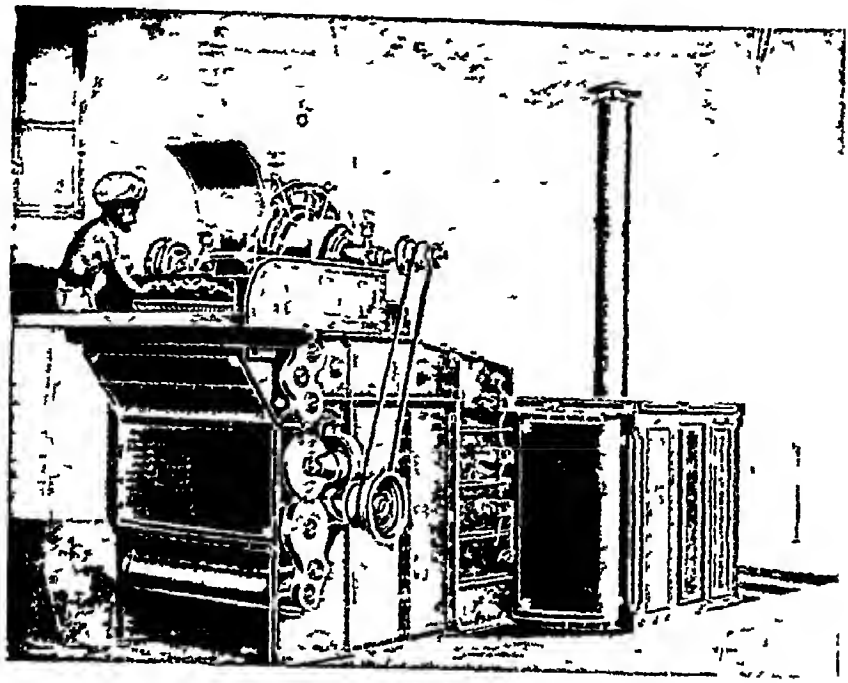

PLATE 21 —Jackson's Paragon Tea Drying Machine

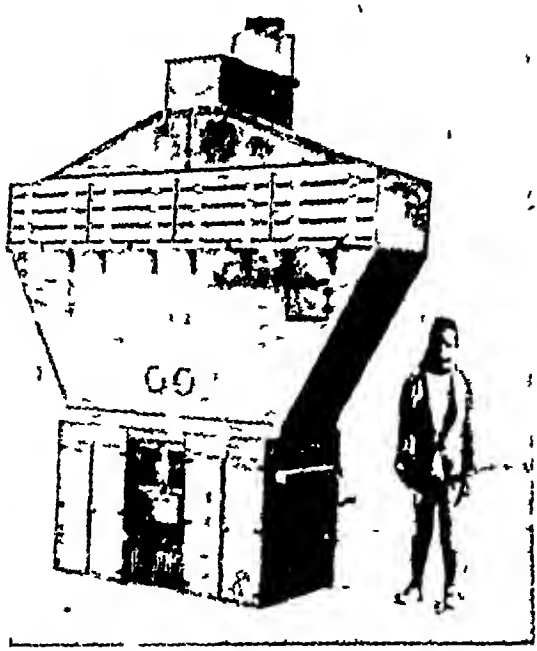

PLATE 22 —Davidson's Up Draft Tea Drier

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leaves are spread thinly and evenly on the trays, for on no account should they be in a dense mass anywhere If there be any heap, the application of great heat would begin to 'stew' it because the steaming moisture inside cannot get away A good drying machine is designed to perform these functions automatically as far as possible, but a machine is not so intelligent as to know what to do in cases of emergency. Hence every machine has doors which may be opened by the operator. He looks into the drying chamber to see that the process inside is proceeding smoothly. Some of these doors need not even be opened, as they have asbestos plates through which the process may be watched

Usually the leaves are put through a drying machine twice so as to dry them thoroughly. In the first process they can stand great heat, being quite sodden, and so the temperature of the air, as it comes out from the stove and enters the chamber, is about 230°Fahr. which is raised gradually to 280° Fahr In the second process, the heat applied is only about 200° Fahr This is lower than the heat

required to boil water and so it may be applied without fear of 'scorching' the dried leaves. Not only must 'stewing' be prevented but the 'singeing' of the leaves would spoil them altogether and contaminate the lot in the chamber by their bad odour. Indeed for many years the prevention of these two mishaps has been the source of anxiety to planters and the subject of patient effort on the part of machinists who have devised these drying machines

'Sirocco' Dryers, patented by Davidson, are justly popular, but the original Drying machine was devised by Jackson whose patents have been built by Messrs Marshall Sons & Co Ltd, of Gainsborough, England This firm has naturally the longest experience in this line and has at last achieved success in the prevention of 'stewing' which may fairly be described as the greatest achievement in the science of mechanical tea-leaf drying In a technical bulletin which this firm has published on 3rd March 1932, the following declarations, of vital interest to advanced planters, are made:

"The control of a dryer to produce quality during the stages of drying tea leaf has for many years provided much food for thought in all minds connected with the tea trade, especially during the last few years of depression when any loss of quality or market valuation represents a serious financial problem After careful consideration of this matter, we arranged for a scientific research to be made on the whole subject of tea drying during the seasonal working periods of 1931.

"The result of the investigation illustrates that sufficient attention has not been given in the past to the regulation of the stewing reactions in tea leaf passing through a dryer, which in a dryer, containing eight superimposed travelling trays are found to vary in an uncontrollable manner from a point between the second and third top tray to one above or below the sixth top tray. These stewing reactions provide a very large variation in tea quality, which naturally has a serious effect on its market valuation

"It is found that the temperature and/or humidity of air escaping from the top tray

surface of a dryer has received considerable attention, but an examination of working conditions does not suggest that any useful purpose can be gained in this direction towards the successful control of stewing reactions produced during the initial drying of tea leaf.

"It is known that stewing reactions are stopped at a temperature of 150°F. It is further found by experiment and proved by practical experience that if the temperature of circulating air be controlled at 150°F at a point between the second and third top trays, that the leaf stewing reactions in the dryer are reduced to a minimum The best initial air conditions are also provided in contact with leaf initially fed to the dryer and during its passage over the first and second top trays.

"The best circulating air temperatures are thus established for the upper travelling surfaces of a dryer by determining that the stewing reactions are best stopped at a position between the second and third top travelling surfaces. The temperature applications under this point will be determined in relation to the

total number of travelling surfaces contained in the dryer and the moisture content found in the leaf discharge

"The Marshall-Reid Anti-Stewing Control has for its object the provision of a special instrument which will indicate from a position situated between the second and third top trays, the actual stewing conditions taking place in the dryer in combination with the temperature of inlet air fed to the dryer.

"The inlet air temperature to a dryer requires further investigation to determine the maximum temperature which can be applied to leaf immediately before it is discharged from the dryer. The maximum temperature will naturally depend upon the percentage of water in the leaf discharge, thus it will be considerably higher for a 12 anna than for a 14 or 15 anna leaf discharge.

"The determination of a maximum temperature of air circulation to a dryer is of the utmost importance to every Garden Manager as such temperature application definitely regulates the possible quantity of leaf which can be treated in a dryer with the minimum of

stewing reactions. Any overload of leaf above that regulated by the inlet air temperature naturally leads to an increase in stewing reactions and loss in market valuation.

"We are now in a position to supply a special anti-stewing instrument at the low cost of Rs 125 each ex our godown, Calcutta. It can be placed in any convenient position near to the thermograph, which indicates the temperature of inlet air circulation. The flexible connection of the special instrument can be taken to a suitable point between the second and third top tray. The Garden Manager will then be in a position to control the working of his Dryer to produce the best possible quality or market valuation in the final tea product

"The latest information on air circulated through a Dryer indicates that the inlet air is best fed to a position under the lowest travelling tray and passed upwards through the travelling trays without any heated air being by-passed to upper tray positions"

In former years, planters tried various experiments in drying by constructing devices in their own factories. In all of them ferm-

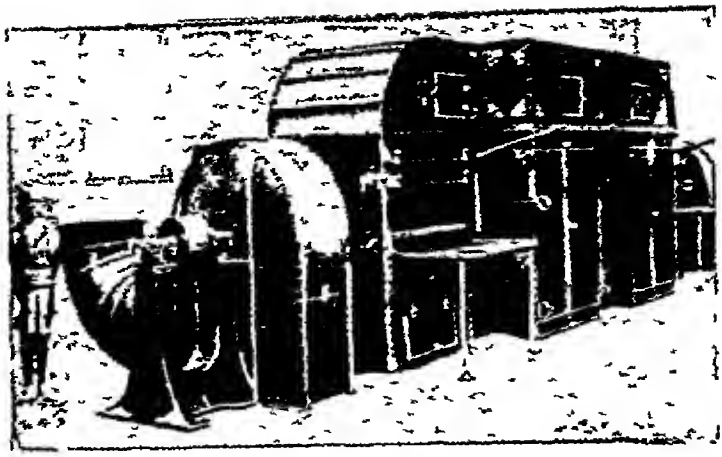

PLATE 23—Davidson's Down Draft Tea Drier

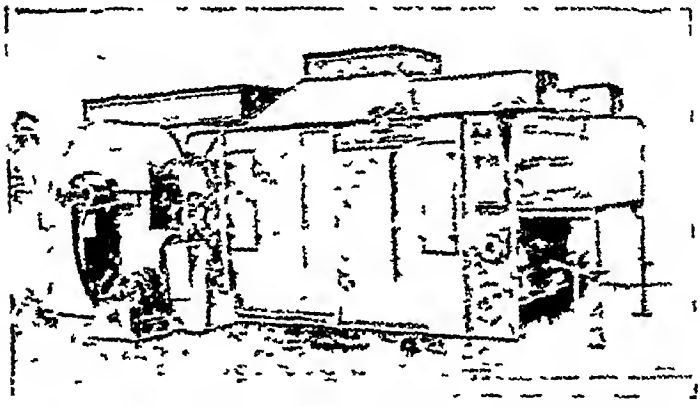

PLATE 24—Davidson's Endless Chain-Pressure Drier

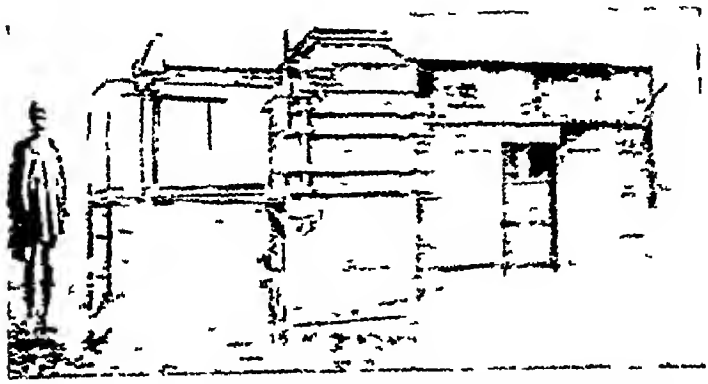

PLATE 25—Davidson's Tilting Tray Pressure Drier

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ented leaf used to be spread thinly and evenly on perforated trays in a drying chamber, but the leaf was not turned over for a considerable time. Although it was spread properly over the containers, being in one position for a length of time, the leaf never dried uniformly. When Jackson introduced his patent he bore this in mind and sought to remedy this as well as other defects of the experimental stage. In his Paragon Dryer the leaf was turned over gently at regular intervals on the trays so that the desiccation was not only uniform but completed more rapidly and economically The latest type of this machine (see Plate 21) turns over the leaf seven times whilst it is carried through the drying chamber on the moving mesh wire trays.

Mechanical action, driven by electricity or some other power, is economically indispensable in a Dryer. Even in hand-drying the leaf had to be spread thinly and evenly and then turned over from time to time For this reason, some of the earliest dryers, such as the Up-Draft Drier (see Plate 22) introduced by Davidson in 1878, which required no me-

chanical power for its operation, left a great deal to be done by hand. But the same maker employed some mechanical means in his Down-Draft Drier (see Plate 23) and even this machine is now regarded as obsolete by advanced planters who rightly favour the use of more automatic machines like Davidson's Endless Chain Pressure Drier (see Plate 24) and the Tilting Tray Pressure Drier (see Plate 25)

In Jackson's Paragon Drier the leaf can be carried through the drying chamber in 10 minutes or this time may be increased to 25 minutes by changing the strap on to the different steps of the cone pulleys The juicy leaf of the spring season would, of course, take longer to dry than the less sappy leaf of autumn. Consequently the differential speeds bring the treatment of any kind of leaf into complete control. In some cases it is thought desirable not to hurry the drying and so, when a slow desiccation is desired, this may be carried out effectually by shutting down the inlets to the fan and running the webs at their slowest speed. This machine has also a me-

chanical feeder which regulates the thickness of the feed, and if at any time it should be necessary the leaf may be scattered by hand on the slowly moving web. Then a large door, lined with asbestos, is fitted on each side of the machine and one on the top so that the whole of the internal working parts can be readily examined at any time.

Davidson's Endless Chain Pressure Drier is deservedly popular on account of its large capacity, economy in fuel consumption and uniform drying. Its operation is practically automatic especially if it is fitted with the automatic feeder and spreader as well as the heater equipped with the mechanical stoker. This Drier is made in two sizes large and small—both machines being identical in design. Davidson's Tilting Tray Pressure Drier is a semi-automatic machine in which the top row of trays, termed the 'feed-drawer,' slides out of the drying chamber, so that the leaf may be spread on it without exposing the attendant to the stream of hot exhaust air. The leaf is transferred from one row of trays to the next lower by turning a handle, an operation

that occupies about eight seconds. This leaves the 'feed-drawer' empty and ready for withdrawal and recharging.

Fermented leaf is generally put through the drying machines *twice,* though some planters, just before packing the tea finally in lead-lined cases, 'fire' the tea once more, as they say, if it has absorbed any moisture after the two drying processes. If the drying is properly done between the standard temperatures already indicated, no tea should come out soft from the driers. In fact, after the second drying, when the fermented leaves become the tea of commerce, the product should leave the drying machine in a *crisp* condition. This may be tested by rubbing it into powder between the palms of the hands.

If there is still any softness in the tea, it has not been dried thoroughly and must be put through the drier once more. Then, the art of developing the flavour of tea and of preserving the virtues of the essential oil, without any 'stewing' or 'roasting' taking place during the 'firing' processes, is no easy task It can be attained only by wide experi-

ence and great care during the finishing stages of the drying operation Moreover, absolute cleanliness in the factory, so that the leaf may not come into contact with oil, grease, paint or any other substance with a bad odour, will help to retain the natural aroma that the tea should possess.

How to retain the virtues of the 'ethereal oil' in tea leaves during the processes of 'drying' and 'fermentation' constitute a great problem which must be further investigated by scientists So far there is not enough of light on the subject and the most experienced planters cannot say definitely how the flavour of tea can best be developed, though they are right in thinking that the solution lies in the proper control of the aforesaid processes. Moreover, we think that climatic conditions to some degree affect this development, for we know that the best teas, fetching the highest prices, are produced at high altitudes or in the sub-tropics.

There is something in the effect of altitude on the flavour of tea. Why is it that tea produced above 5,000 feet in the Darjeeling or

the Nilgiri Hills has usually a better aroma than tea grown in the lower hills or anywhere in the plains? Probably the reason is that, besides selective conditions under which tea may be cultured and manufactured any where, a high altitude has a very pure atmosphere. This purity of air enables the tea to retain its natural fragrance like the refreshing scent of flowers growing at high elevations.

SIFTING, SORTING AND PACKING.

Strictly speaking, *sifting* consists in rejecting all foreign matter—such as chips broken off from leaf-baskets, mats, wire containers, etc—which get mixed up with the leaves in the field or the factory. In this process are also picked out and discarded all long stalks and hard leaves which have not taken the usual twist in the withering and rolling operations but have remained flat somewhat In fact, from the prepared tea must now be thrown out all admixtures and impurities in which consists the process of *sifting,* although this word is sometimes used to convey what should really be termed as grading. Obviously, cleaning is the first thing to be done

PLATE 26—Sifting tea by hand with *chalnees* The mechanical grader seen behind moves to and fro separating the sizes but cannot reject the admixtures like the hand process

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before the tea can be sorted, graded and packed. Sifting is best done by young women using tweezers or *chalnees* which are hand matted trays as seen in Plate 26

After sifting, the product is *sorted* or graded in sieves, of different sizes of mesh, worked horizontally. At first it is best to separate the coarse from the fine product by using a No. 6 sieve (with 6 square or rectangular spaces to the square inch). When worked by power, these horizontal sieves are made to revolve or oscillate to and fro. A good machine for this purpose is Davidson's Sirocco Tea Sorter (see Plate 27) which cuts the coarsest tea and sorts all the tea into 5 different grades, as desired by the planter. According to money, *sorting* should be done under the following heads:

Leaf.

(1) Flowery Orange Pekoe, (2) Orange Pekoe, (3) Pekoe, (4) Pekoe Souchong, (5) Souchong, (6) Congou, and (7) Bohea.

Broken

(1) Pekoe, (2) Souchong, (3) Mixed, and (4) Fannings.

Dust—all kinds.

Money's aforesaid system of grading is a general classification for all possible kinds of black tea But, practically speaking, such tea is to be classed only according to the grades produced in a garden. "For gardens which produce fine teas," says Mr. Claud Bald, "only five classes are necessary, viz: Broken Orange Pekoe, Orange Pekoe, Pekoe, Pekoe Souchong and Pekoe Dust (or Fine Broken Tea). The first consists of terminal buds and embryo buds with portion of the finest leaf, which have got broken off during manufacture; the second consists of some terminal buds and the finest leaves; the third and fourth consist of the coarser leaves; while the fifth consists of the fine powdery fragments broken off from all the others and includes also flaky scraps of the leaves, sometimes called 'fannings'" *

In the drying processes, there should be as little broken tea as possible and only very hard or coarse tea may be cut after it has been separated from the rest. Broken tea fetches

* Bald's *Indian Tea*, p 185.

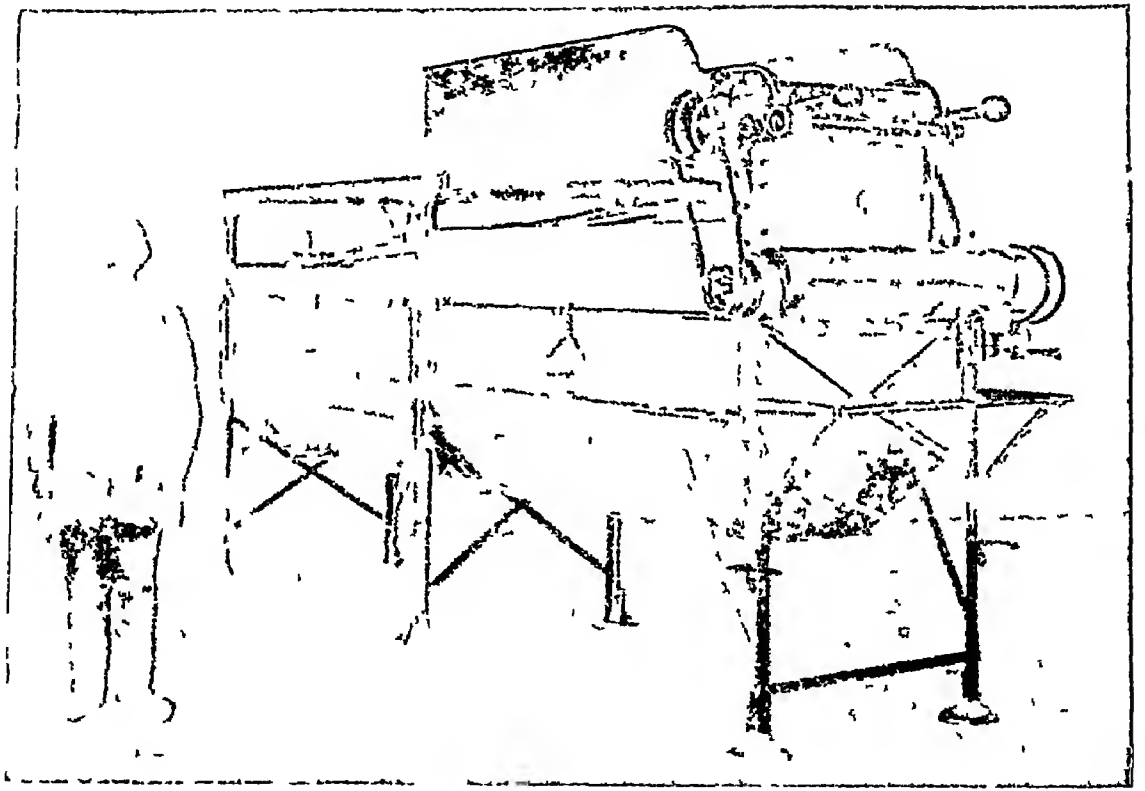

PLATE 27—Davidson's Strocco Tea Sorter

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a lower price than leaf tea and dust tea lower than broken tea. But if broken, tea is easier to soak and has a more pronounced liquor and flavour after brewing (for the usual 4 to 5 minutes) than leaf tea of the same grade In consequence, broken teas fetch very fair prices Here it may be added that the manner in which black tea should be brewed depends upon the nature of the tea (leaf, broken or dust) and also upon the climate in which the brewing takes place A good tea taster should be the best guide on this subject

Small gardens are not expected to have more than 4 or 5 grades of tea, though large gardens have usually 7 or 8 grades-following more or less the classification given above by Money. Some of the estates subdivide Pekoe into No. 1 and No 2. In sorting efforts should be made to maintain uniform standards, if possible, year after year. At least if the variations in each grade are slight, the standards will be easily recognized and much prized in the market.

When tea is fully manufactured, it should be *stored,* only for a few days, in bins well

covered and protected from dampness. Tea absorbs moisture most readily from the air or the ground. Once it does so, it is damaged for good. It gets soft and mildewed, which is probably the attack of a fungus known to mycologists as *Penicillium, Aspergillus* or *Sterigmato Cystis.* When tea is thus attacked, it begins to decompose. Though this process may be arrested for a time by ' firing ' the tea, the product cannot be brought back to its sound and healthy condition. Consequently, it is imperative that scientists should investigate into this matter and indicate the best way of *preventing tea from absorbing moisture* and getting mildewed prior to the final packing in air-tight cases

Before the final firing and packing, proper *chests* must of course be obtained and lead-lined. After the last ' firing, ' the tea should be cooled for a while and then packed warm out not too hot. The chests must be lead-foils soldered perfectly air-tight. Each case usually contains tea weighing 80 lbs or 100 lbs nett besides 2 or 3 ounces of tea which is added as a sampling allowance Both tare

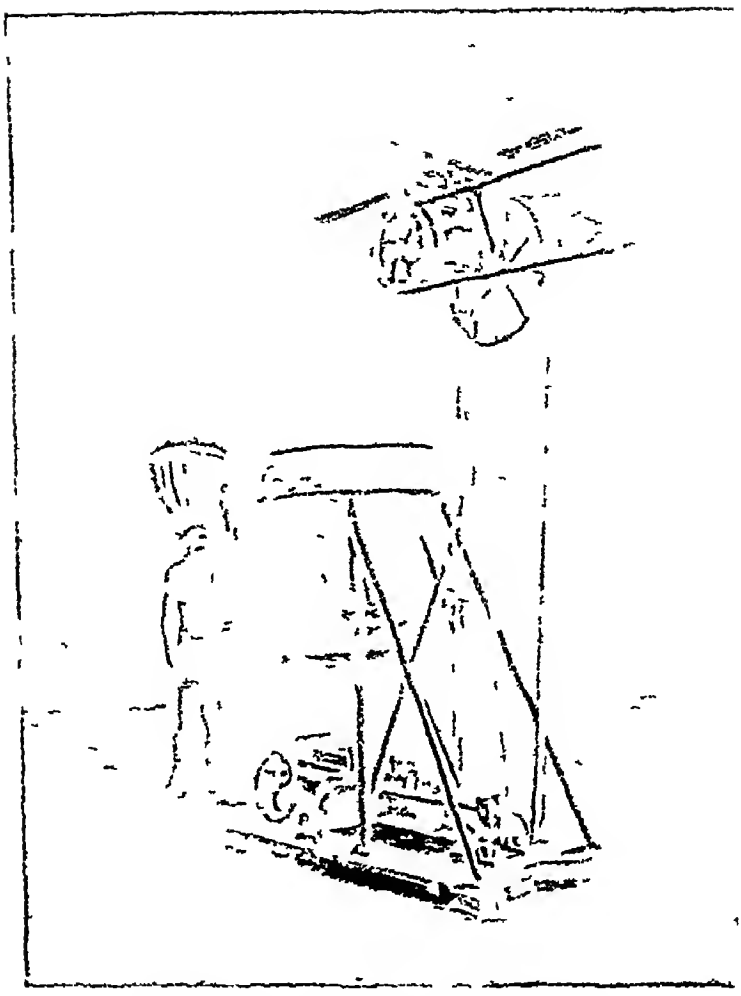

PLATE 28—Davidson's Tea Packer

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and nett weight must be marked on each case apart from the other marks. Tea must not be packed loosely for then it would suffer by friction during transit. Besides loose packing means the need of more cases to pack a given quantity and so is decidedly wasteful

The contents of each chest should be quite though not forcibly pressed. In a packing machine, the chest is subjected to a vibratory motion while the tea is being poured. A good machine of this kind is Davidson's Tea Packer (see Figure 28) The tea packed by this machine is neither broken nor crushed, while 5 to 8 per cent. more tea can be put into each chest than by hand-packing. A word should be added here about packing cases. Usually various kinds of timber, suitable for making such cases, are available from trees in or near plantations in India They are so numerous and well known in every tea-growing district, that they need not be detailed here.

Of course, only the best kinds of wood should be selected as tea chests need to be in perfect condition despite shipments to London and thence to other ports Often these chests

remain in ware houses and grocers' stores for an entire season. Suitable timber must first be cut into scantlings and then well seasoned before being used for the making of tea chests. Unseasoned wood should never be used because it is heavy, requiring extra freight, also it is liable to warp and attack by fingi and insects.

CHAPTER IX.

THE WORLD'S TEA STATISTICS.

PRODUCTION AND DISTRIBUTION.

FROM about the beginning of this century, when tea began to be consumed throughout the world, its cultivation naturally spread from the East to other countries. At the present day the chief tea-producing localities in all parts of the globe, roughly in order of their relative importance, may be enumerated as follows—India, Ceylon, China, Java, Japan, Indo-China, Burma, Natal, Sumatra, Malaya and the Caucasus Tea is also grown in small quantities in the West Indies, North of Florida, British North and South Africa, Siam, Fiji Islands, Tahiti, Borneo and the Philippines Regarding tea statistics, though reliable figures are available for production only in the principal countries, consumption figures are inferred from indirect sources Trade figures are, however, obtainable for most countries

During this century both production and consumption of tea have been steadily progressing, not only due to the growth of population but to the extension of the tea-drinking habit. There is indeed some indication at present that this habit will spread among civilized nations because the use of alcoholic drinks is becoming less conspicuous in the United Kingdom and is altogether banned by legislation in the United States of America. Nor has any synthetic stuff the chance of ousting this natural product from its position as a staple beverage. All prospects are consequently favourable for the steady increase of tea consumption in the civilized world. In 1929 tea-drinking, per head of population, stood as under in the following countries: 9·4 lbs. in the United Kingdom, 9 lbs. in New Zealand, 8·3 lbs. in Australia, 7·6 lbs in the Irish Free State, 4 lbs. in Canada, 3·2 lbs. in Holland, 1·7 lbs. in South Africa, ·84 lb. in the U. S A., ·27 lb. in European Russia, ·18 lb. in Germany and ·07 lb. in France.

In recent years tea prices have dropped mainly owing to the economic causes of the

universal trade crisis which have brought down the values of all agricultural products and it is scarcely due to any visible over-production. Excess of production is a relative phrase It is related to actual, not potential consumption. It is apparent, however, that some countries, such as Russia, have begun to produce tea within their own territories or to buy more largely from their own colonies. During this century, the world's annual consumption of tea has steadily increased to nearly 900 million pounds at the present time This excludes tea consumed in China for which figures cannot even be reasonably conjectured.

THE WORLD'S PRODUCTION.

Roughly speaking, at present the tea production of the world is nearly 900 million lbs. —430 million lbs. in India from 789,000 acres; 250 million lbs. in Ceylon from 403,000 acres; 150 million lbs. in Java and Sumatra (chiefly the former) from 255,000 acres; 25 million lbs. in Japan; and some 35 million lbs. in other countries excluding China. It is probable that China produces some 300 million lbs. but this figure is purely conjectural. Put in tabular

form the world's known tea production would seem to be something like the undernoted figures:—

India	.. ..	430 million lbs.
Ceylon	.. ..	250 „ „
Java and Sumatra	..	150 „ „
Japan	.. ..	25 „ „
Other countries excluding China	.. ..	35 „ „
	TOTAL ..	890 million lbs.

Though the original home of the tea plant was in China or in Assam, which are both sub-tropical regions, the cultivation of this plant has spread mostly to the tropics near its real home. Probably the reason for it is that the knowledge of its culture spread most easily to these neighbouring countries which also had the plentiful labour required for its cultivation and manufacture. But we now find that tea yields its best qualities in the humid sub-tropics or at high altitudes within the tropics. The plant yields, however, abundant crops of common tea inside the tropical belt

EXPORTS FROM THE CHIEF PRODUCERS.

The quantity of tea exported from the principal producing countries during this century are as under:—

Year	From India lbs	From Ceylon lbs	From China		From Java lbs
			lbs Black & Green	lbs Brick, Tablet & Dust	
1900-01	192,300,658	149,264,603	144,270,933	52,190,667	-
1905-06	216,770,366	171,256,703	112,152,533	70,784,267	25,650,156
1910-11	256,438,839	186,925,117	123,947,734	84,158,943	40,639,185
1915-16	340,433,163	214,900,383	143,662,000	93,776,667	101,603,335
1920-21	287,524,697	184,770,231	38,908,800	1,809,867	93,680,400
1921-22	317,566,850	161,610,966	53,892,533	3,484,633	67,775,200
1922-23	294,700,469	171,807,581	73,336,933	3,472,800	80,860,300
1923-24	344,774,111	181,939,731	98,042,133	8,813,467	90,302,300
1924-25	348,476,011	204,931,217	91,345,333	10,779,333	105,113,200
1925-26	337,314,872	209,791,384	88,019,600	23,048,133	94,774,200
1926-27	359,140,132	217,183,666	82,896,500	29,012,400	118,928,400
1927-28	367,387,340	227,037,856	77,609,900	38,680,000	126,905,700
1928-29	364,825,575	236,719,384	76,850,667	46,618,933	134,373,200
1929-30	382,594,779	251,588,012	85,949,067	40,414,933	136,728,400

From the aforesaid table it is obvious that during this century, the exports from India and Ceylon have grown steadily while those from Java have augmented in greater proportion since the war period. Also it seems that from 1917 to 1922 the exports from China dropped off suddenly and have since then been trying to recover although they have not yet come up to the pre-war quantity China seems to have made some room for Java in the world's tea trade and the latter island has entered into competition even with Ceylon and India. Also, we may observe that, though tea-growing has spread to other parts of the world in this century, these new localities have not affected the world's trade unless it be the Caucasus which has helped Russia to lessen her imports visibly from the outside world.

During the last two decades of this century the following countries imported tea, amounting to the undernoted quantities in *millions* of pounds (avoirdupois) from the chief producing countries This table is of special interest to such countries. The United

Kingdom re-exported 25% to 30% of her imports to other countries.

	Pre-war Average	War Average	1927	1928	1929	1930
	(in million lbs)					
United Kingdom.						
From India	189	233	303	289	307	290
„ Ceylon	112	100	142	139	153	152
„ China	19	17	12	6	9	8
„ Java	18	18	75	71	85	84
Total	349	377	537	508	560	541
United States of America.						
From India	6	10	13	15	14	16
„ Ceylon	18	19	24	28	27	28
„ China	22	18	10	9	9	6
„ Japan	46	49	26	23	24	21
„ Java	—	8	6	6	6	5
Total	95	107	89	89	89	85
Australia.						
From India	8	8	2	6	5	4
„ Ceylon	20	23	19	19	25	16
„ China	3	2	1	1	1	2
„ Java	4	8	22	24	19	23
Total		41	45	50	50	46
Canada						
From India	14	13	22	23	24	33
„ Ceylon	15	10	10	12	10	13
„ China	3	2	1	1	—	—
„ Japan	4	5	3	3	3	3
Total	36	†30	36	39	38	50

†The war average of imports into Canada was 34 million lbs including over 4 million lbs imported from Java annually

From the aforesaid table it appears that since the second decade of this century the United Kingdom has increased her tea imports remarkably, the United States of America have remained more or less stationary, Australia has improved perceptibly while Canada has made little visible progress. The progressive buyers, therefore, were the United Kingdom and Australia. Obviously, the cause of the improvement in the case of the United Kingdom, was largely her increasing re-exports to foreign countries, as will appear presently.

Apart from tea consumption in the producing countries which is considerable, the absorption of this product by the rest of the world may be viewed from the following table which shows the *import* of tea for *home* consumption in countries that do not produce tea. Statistics of this kind for recent years are difficult to procure for all such countries, but it is probable that the total home consumption of these countries has come to about 900 million pounds in 1933, to forecast from recent figures of some of them.

Importing Countries	1927 lbs
Great Britain & North Ireland	416,152,552
United States of America	88,518,696
Australia	49,672,000
Canada	38,116,897
Russia (European)	35,794,450
Irish Free State	23,767,045
Holland	22,453,000
Persia	12,000,000
Union of South Africa	11,812,072
Germany	11,409,361
Morocco	11,000,000
New Zealand	10,827,381
Countries consuming less than 10 million lbs each	60,825,046
Total	792,348,500

The exports of the world's leading tea producers in *tons* (not lbs) were as follows:—

	1929 Tons	1931 Tons
British India	171,893	153,560
Ceylon	114,117	109,538
China	41,060	30,000
Japan	10,479	9,170
Formosa	8,343	10,299
Dutch East Indies	68,311	73,831
Total Tons	414,203	386,398

STATISTICS OF INDIAN TEA PRODUCTION.

In 1929 the total area of tea gardens in India was 2,524,690 acres, but about one-third of it, namely, 788,842 acres, was actually under cultivation and pluckings were made from only 708,700 acres which seemed to contain mature or healthy plants as there was no policy of restriction. Of the total area in India, about 78 per cent is in North-East India (consisting of Assam, the Dooars, the Terai, Chittagong and Darjeeling districts), about 17 per cent in Southern India and 5 per cent in the rest of the country. The chief localities are as follows:—

(1)	Jalpaiguri District (East & West Dooars & Eastern Terai)	128,120 acres
(2)	Lakhimpur District in Assam	104,438 „
(3)	Sibsagar District in Assam	99,727 „
(4)	Sylhet District in Assam	90,517 „
(5)	Travancore State in South India	65,397 „
(6)	Darrang District in Assam	61,266 „
(7)	Darjeeling District in Bengal	61,154 „
(8)	Cachar District in Assam	54,257 „
(9)	Nilgiri District in Madras Presidency	31,787 „
(10)	Coimbatore District in Madras Presidency	22,489 „
(11)	Malabar District in Madras Presidency	12,543 „
(12)	Nowgong District in Assam	11,949 „
(13)	Kangra District in the Punjab	9,702 „

(14) Tripura State in Bengal	—	7,895 acres
(15) Chittagong District in Bengal	—	5,895 „
(16) Dehra Dun District in the United Provinces	—	5,057 „
(17) Kamrup District in Assam	—	3,531 „
(18) Goalpara District in Assam	—	3,421 „
(19) Mysore State in South-India	—	3,264 „
(20) Ranchi District in Bihar & Orissa	—	2,113 „
(21) Purneah District in Bihar & Orissa	—	1,931 „
(22) Almora District in the United Provinces		756 „
(23) Sadiya Frontier District in Assam	—	499 „
(24) Coorg District in South India	—	415 „
Other Places	—	836 „
Total	—	788,842 acres.

In 1929 the total number of plantations was 4,714 in all India, their sizes varying very greatly In Assam 993 gardens had 429,605 acres under tea, that is, an average of 433 acres per garden. In Bengal the average size of 388 plantations is 524 acres, and in Travancore the average size of 122 gardens is 536 acres each In Mysore, Bihar and Orissa, the United Provinces, Madras and Cochin, the average is much smaller being about 218,177, 159,102 and 99 acres respectively In the Punjab there are 2,477 gardens the average area of each being under 4 acres The average

out-turn per acre also varies enormously. In Madura it was 903 lbs., in Lakhimpur 814 lbs. in Jalpaiguri 705 lbs., in Darrang 686 lbs. Sibsagar 618 lbs., Coimbatore 600 lbs., Travancore 595 lbs., Sylhet 574 lbs., Cachar 523 lbs., Nilgiris 512 lbs., Darjeeling 390 lbs. Dehra Dun 281 lbs, Kangra 200 lbs., Almorah 120 lbs and Mysore 73 lbs.

In 1929 the total production of both black and green tea was 432,998.000 lbs. of which black represented 428,913,000 lbs. produced throughout India. In 1930 the area under tea increased slightly but the production diminished somewhat as compared with 1929. From final figures published in 1932 (by the Department of Statistics in Calcutta) the area under tea in 1930 was 805,800 acres of which 719,800 acres were plucked, as compared with 788,842 acres under tea and 708,700 acres actually plucked in 1929. Estimated total production of black and green tea in 1930 was 391,081,000 lbs. of which black represented 385,852,000 lbs as compared with 432,998,000 lbs. of both black and green in 1929 when there was probably some little excess of production.

According to the latest figures published (in March, 1933) by the Department of Statistics in Calcutta, the total area under tea in India during 1931 was 807,400 acres as compared with 803,200 acres in 1930. Of this area, 77% lay in North-East India consisting of Assam Province and parts of the Bengal Presidency The latter include Darjeeling District, Jalpaiguri District (otherwise known among planters as the Dooars and the Terai) and Chittagong Also, of this area, 18% lay mostly in the elevated region of South India consisting of the States of Mysore, Travancore and Cochin as well as the British Districts of Malabar, Nilgiri and Coimbatore. And only 5% lay in Kangra Valley and Dehra Dun in North India as well as in Ranchi in the Bihar and Orissa Province

Of the total area of 807,400 acres in 1931, only 732,400 acres were plucked as compared with 719,800 acres plucked in 1930. On the remaining 75,000 acres, the plants were either too young or could not be plucked. In 1931 the total number of plantations was 4,840 as against 4,743 gardens in 1930 This increase

is remarkable in spite of the depression In 1931 the total production of both black and green tea is estimated at 394,083,000 lbs. (of which black was 390,687,000 lbs) produced in the under-noted areas:—

	1930	1931
Assam	233,416,000 lbs	243,229,000 lbs
Bengal	98,241,000 „	90,096,000 „
South India	54,896,000 „	56,603,000 „
North India	3,719,000 „	3,269,000 „
Bihar & Orissa	809,000 „	886,000 „
TOTAL	391,081,000 lbs	394,083,000 lbs

In 1931-32 the quantity available for home consumption in India is estimated at 63 million lbs

In recent years the total exports of tea from India were as follows:—

Year	By Sea. lbs	By Land lbs.
1926-27 ..	350,502,000	12,379,000
1927-28 ..	362,012,000	8,892,000
1928-29 ..	359,784,000	8,424,000
1929-30	377,142,000	8,855,000
1930-31 ..	356,918,000	8,287,000

In 1930-31 the exports declined both over sea and land. By sea they declined by 20 million lbs or 5 per cent as compared with 1929-30. This decrease was chiefly in the exports to the United Kingdom, Egypt, Canada, Arabia, Anglo-Egyptian Soudan, Union of South Africa, Iraq and Persia An increase on the other hand occurred in shipments to China, Ceylon, Bahrein Islands, Russia, Georgia and the United States of America. In 1930-31 Russia took 6,244,000 lbs as against 5,299,000 lbs. in 1929-30.

Reliable figures for 1932 tea production in India are not yet available as records of leaf plucking and tea manufacture are more difficult to get than the returns of other agricultural crops In fact statistics of production are obtained from figures of areas plucked and normal out-turn per acre, these being finally verified by total exports being added to average annual consumption But the yield of the tea crop per acre is not the same every year and averages are only approximate

Exports of tea from India also declined in 1930-31 as shown above Consequently the

conclusion is inevitable that in 1931 and 1932 there was probably over-production in India Again it is impossible to say from available data if there was any under-consumption throughout the world—a condition which is very improbable. The chief cause of the present tea crisis has, therefore, to be sought among the general causation that has resulted in the universal economic depression due mainly to the rise in the value of money every where.

CHAPTER X.

THE WORLD'S TEA MARKET.

CENTRES IN LONDON AND CALCUTTA.

PRIMARY agricultural produce, like wheat, rice and corn, are raw products which have a free and wide system of distribution leaving to the producers an open market which may be local, national or universal. Even when the crops are pledged to agricultural banks or money-lenders, the latter act as buyers or middlemen in a market that is competitive and unrestricted Unlike such produce, tea is a manufactured agricultural product the vast bulk of which goes from the tea factories to managing agents or marketing associations who sell in bulk to a few closed marts that are highly centralized. In the world's tea business, the producers are seldom or never the distributors

In India the managing agents usually consign the tea direct to London to be sold there at the Auction Rooms in Mincing Lane

and sometimes they sell qualities, meant mostly for India and the Asiatic ports, in the Auction Rooms at Mission Row in Calcutta The large tea companies invariably have such managing agents who dispose of tea in this manner. Tea prices are thus contrived and promulgated both in London and Calcutta. Sometimes also these agents sell the tea outright to ports in Asia, Africa, Europe and Australia, but the amount so exported represents only a small part of the Indian crop The tea auctioned at the mart in Calcutta is bought usually by Indian merchants for sale in India or the near ports

Much as Calcutta is the biggest port for the initial distribution of tea from North-East India to London and abroad, London is the biggest centre for the re-distribution of the world's teas to the West because Great Britain herself is by far the largest consumer of tea in the globe The dissemination of tea from Ceylon and the Dutch East Indies to London and elsewhere is conducted by agencies in much the same fashion as in India. Under this system there are exclusive sale organiza-

tions. In all these large tea producing countries, the functions of distribution are kept quite separate from those of production—as in the manufacturing industries—for the specialization of functions cannot be attained without the division of labour backed by co-ordination. Moreover the planter can know little about distant markets

Still the initial distribution at the ports of shipment in these countries is highly centralized and has little or nothing to do with the subsequent marketing which is undertaken by merchants and traders. Though there is some co-ordination between the tea companies and their managing agents and less between the agents and auctioneers, further responsibilities are not taken after the tea passes through the auction rooms. Both in London and Calcutta there are, however, only a few recognized tea auctioneering firms through whom must pass all the tea consigned for auction. Each auction firm has at least one expert tea taster who assesses the price-limits for each lot. This is merely to guide the bidders and brokers in judging values.

The auctioneering firms also regulate the quantities that are offered on each sale day and have some idea of existing stocks at least in the local mart. It is certain, therefore, that these firms take the initiative in determining values for the world's tea market and must do so on sound economic lines.

THE SYSTEM OF DISTRIBUTION.

At auction sales in London, the initial buyers consist of about half-a-dozen large co-operative distributors, a few blenders, some shippers and some grocers' combines who own about 6,000 retail shops. The capital of each of these wholesale distributors runs to about £1 million sterling In addition to such customers, there are in Great Britain between 60,000 and 70,000 retail tea sellers who have seldom any connected interests with the big auction buyers but they serve exclusively the domestic consumers. These retailers are not represented at Mincing Lane They purchase from well-known blenders or large houses whose turnover exceeds 100 million lbs. annually and who spend over £100,000 per annum in advertising Though some of the big

distributors compete with each other to some degree, if their interests were attacked in any way, they would combine to fight against the common assailant.

In 1932 some planters in the Dooars suspected that there were 'rings' among the auctioneers in London who, it was stated, 'openly arranged to split invoices at their own prices and the auction part of the proceedings was conspicuous by its absence' If such was the case, no tea companies or managing agents would have any confidence in the auctions. The auction firms are not buyers themselves nor can they favour the bidders because they are paid only a brokerage calculated on the sale-proceeds, which is the usual custom If there is ever a departure from this practice and a commission is paid per chest or lot of tea handled, there may be room for complaint which the planters could make to the managing agents Only under such slip-shod arrangements could the auction firms work in the interests partly of sellers and partly of buyers.

A code of business ethics is undoubtedly observed at the auction rooms in London and

Calcutta The auctioneers in their own interests must secure the highest prices possible, prevent friction among the sellers and attract the largest number of buyers And, of course among the bidders there must be rivalry. But if they combine, the auctioneer cannot be blamed. From the standpoint of producers, the weakness of competition among distributors or the low prices offered by consumers are certainly not helpful. But there could be no escape from the difficulties of the present crisis by resorting to the sale of your own tea.

It is not possible for producers to make their own arrangements in Great Britain for distribution on a large scale. It has been computed that to start distributing agencies similar to those that exist throughout the country would not only involve the outlay of capital running to millions of pound sterling, but producers could neither organize nor earn profits so well as these experienced distributors. Provided there is co-operation among them, the profits of these distributors may be about as much as those of the producers; and, certainly these sellers do not undergo the risks due to

climatic variations and trade vicissitudes that the planters have to reckon with.

Plantations must face with some philosophy the present inevitable circumstances. Should they desire to get out of the hands of the auctioneers and sell direct to the wholesalers, the gain would be little and they would lose the primary link to and convenient barometer of the universal tea market. If the planters desire to ship their teas direct to the various consuming countries in the West, the importers there could not buy except upon London prices after ascertaining the stocks in that great centre London has become the first centre of the universal tea trade because Great Britain is the biggest tea consumer in the world and this position is not due to any favoured circumstances Of course the efficient sale organization in Great Britain is the result of years of experience

The system of distribution in India is not so exclusive and centralized as in Great Britain. India herself consumes something like 60 million lbs. and sells outright to foreign ports, other than London, more or less an equal

amount every year. These consist mostly of the medium and lower grades Tea companies in North-East India, having managing agents, sell usually at the auction rooms in Mission Row all qualities suitable for India; and those required for markets in Asia, Africa, Australia and South Europe are shipped direct from the ports of Calcutta and Chittagong

But tea estates in North-East India, who have no managing agents, are free to sell anywhere they like and avail themselves of the open market that exists for tea required for home consumption They sell at Mission Row or to merchants in Calcutta, wherever they get good prices and quick sales. Indian tea merchants buy mostly from Mission Row and sometimes from such tea estates, after which they sell to stock-holders in Bihar, Orissa, Burma, the Central and the United Provinces.

The tea estates in North-West India sell direct to stockists at Amritsar, Lahore, Rawalpindi, Srinagar and Peshawar. A portion of this tea goes overland to Afghanistan, Central Asia and even Persia. Southern India tea estates sell direct to merchants in the Deccan,

excepting a few with managing agents who export abroad from Madras Tea estates, other than those in North-East India, have no use for the auction rooms at Calcutta Sind, Beluchistan and the Bombay Presidency buy tea partly from North-West India and Southern India estates and partly from Ceylon and Java

All over India, tea merchants and stockists sell to grocers, retailers and general traders in their own provinces. Tea estates sometimes sell direct to local dealers but seldom or never could they afford to pay postal charges or railway freight and sell retail to distant consumers in a sub-continent like India.

PACKING HOUSES AND THE CESS COMMITTEE.

To make up for the losses, incurred by producers in the tea slump, suggestions were made recently by some planters to have central houses for blending, packing and marketing. They were encouraged in this suggestion by the apparent high profits made by houses like those of Lipton, Lyon and Brooke Bond, also by a phase of the Indian Tea Cess Committee's activities by which tea in bulk is purchased and

blended, packed and sent out to stockists in India. This scheme is not likely to prove lucrative to planters who have enough to do with tea growing and manufacture to be able to make a success of the details of distribution. Quick sales must always be effected and yet the market must never be flooded because tea, unless packed in vacuum, deteriorates in a damp, tropical climate very rapidly.

A problem with the aforesaid houses always is how to get rid of out-of-condition teas, and planters could seldom specialize in this branch of the tea business. If the Tea Cess Committee could increase tea consumption in India, there would be a scope for the advent of new firms to operate as blenders, packers and distributors. And, the Committee would succeed in this direction if they took the help of educated Indian youths for purposes of propaganda India is recognised as a great potential market for the expansion of tea consumption, apart from the U. S. A and the U. S. S. R Apparently the home market has not been properly tapped as yet because the funds of the aforesaid Committee are derived from a cess

on the export of tea and not on its sale in India. Those who sell here are, however, no other than those who produce for export.

Russia (the U S S R) is the only big market that offers a ready opportunity for the extension of consumption without a selling campaign by the Indian Tea Cess Committee Russia merely desires a year's credit on tea purchases against security which only a few British firms will allow At the annual meeting of the Indian Tea Association, London, in July 1932, the Chairman, Mr. R Graham, expressed regret and astonishment that, while some firms sold on credit to Russia, others were unwilling to do so He was supported in this view by the Vice-Chairman Mr E A. Watson Moreover, Mr J F Muir at the annual meeting of the Consolidated Tea and Land Company of Glasgow, held in June 1932 said that his company along with some others were giving credit to Russia and they hoped to convince her that it would pay the Republic better to depend on their tea rather than to grow it in its soil and climate which was not suitable.

By the Soviet five-year-plan, the Republic hopes to grow in South Russia some 45 million lbs of tea or about half of her present annual requirements The pre-war consumption of Empire Tea in Russia was roughly 80 million lbs. per annum and even in 1927 she is said to have imported nearly 36 million lbs., also in 1927-28 Russia is reported to have taken directly from India 6⅔ million lbs. Her recent imports are not known though they may probably be near 10 million lbs. a year. It is useless to quote figures for the U. S. S. R. which seem to be very unreliable

Owing to the vigorous campaign of the Indian Tea Cess Committee, the sale of tea in the U S A has grown in recent years remarkably. In 1929 the export of Indian tea to America was 18,010,177 lbs., in 1930 it was 20,692,522 lbs., and in 1931 it had risen to 24,663,556 lbs. The U. S A. buys tea more largely from Ceylon and Japan. So long as 'Prohibition' continues in the U. S. A., the Committee should not slacken their campaign in that country. But the most progressive country in this respect is Great Britain herself

whose consumption of 439¼ million lbs., in 1930 had risen to 461¾ million lbs in 1931

THE FAILURE OF IMPERIAL PREFERENCE.

If there was a steady expansion and no falling off in the consumption of tea, also no universal economic crisis and less production of inferior grades in Java and Sumatra, there would be little fear of a glut in tea. But it is usually when prices fall from a combination of these causes that some planters are tempted to 'pluck coarse' or 'go all out,' as they say, to make up by quantity what they lose in value. Instead of such a desperate step and the abandonment of voluntary restriction in January 1931, there might have been more co-operation from such planters It is true that only a local or temporary glut is soon passed over, but the latest figures from all producing countries seem to show otherwise, as will appear presently

Early in 1932 the rapid increase of exports from Java and Sumatra was sought to be countered by protective duty in Great Britain and later on by imperial preference at Ottawa In April 1932 the British Chancellor

of the Exchequer, when disclosing his Budget along with his historic Protective Tariff, announced an import duty of 2d per lb. on empire tea and 4d. per lb. on foreign tea coming into Great Britain. He also declared that an excise tax of 2d. per lb would be levied on teas already in the country. Later on it was discovered that no less than 114,960,000 lbs of tea were stored otherwise than in public warehouses, obviously due to the frantic rush made by exporters prior to the Budget to ship the world's residue to London with the object of evading the anticipated taxation.

Since there are no Bonded Warehouses for tea at present in England, a correct census of stock in the country could not be taken by the Chancellor, but he was obviously more shrewd than what the trade took him to be. Anyway, this excise tax with a 50 per cent Empire Preference, was hailed as the salvation of growers within the British Empire. But its sole or instant result was a weakening of the market for all growths, with foreign tea selling at 2d. below Empire sorts. The cheap

teas of Java and Sumatra seemed to suit the lower level of taste or the depleted purses of the people They took hold of the general public and became indispensible at least for blending purposes.

Mr. Neville Chamberlain's fiscal policy failed in its avowed object because the Dutch teas easily jumped over the tariff walls that he raised and so the empire growers cried for more protection Then, in the autumn of 1932 the Ottawa Conference held out hopes to them of Imperial Preference from Canada, Australia, New Zealand, South and East Africa. The last two colonies were at the time consuming partly the tea grown in Africa, and Australia, owing to her serious economic crisis, was buying the cheap teas of Java and Sumatra considerably At the Coference it was agreed that preferential treatment would be accorded to Indian and Ceylon teas on a basis of reciprocity within the Empire

ECONOMIC CRISIS. EXCESS STOCKS AND FALL OF TEA.

The Ottawa Agreement has not yet been ratified or put into operation in all parts of the Empire, but Canada, New Zealand and

East Africa are likely to exclude foreign teas. In any case, as Imperial Preference is not likely to bring any visible relief to the tea slump, the London Branches of the Indian and Ceylon Tea Association have negotiated with the Dutch Government for a Scheme of Restriction. The present tea slump is the worst in the history of this industry and its dominant cause is the world economic crisis beyond any doubt. Since 1929 there has been a fall in the 'general price level,' i.e. in everything that is priced in or measured by money owing to the growing scarcity of gold. This fall in value was only natural when the currencies of most countries were based on gold.

Not only have agricultural products fallen in price, but all commodities including manufactured goods; in other words, there was first a decline in the 'commodity price level.' Now, if the decline was confined only to commodities, we could say that it was due either to the devaluation of currencies or to over-production or to under-consumption. But when wages and values of services have also declined, in fact, when everything that is measured by

money has fallen in value while merely the price of gold, the value of money and interest on capital have risen, we must infer that the fall in the 'general price level' is due primarily to the gold scarcity There is a well-known law in economic life, formulated under the 'quantity theory of money,' that explains this phenomenon.

Now, in addition to the fall in the 'general price level,' there has been in tea some under-consumption or relative over-production resulting in a steady decline of prices due to the reducing buying power of the world. For this over-production Java and Sumatra have been mainly responsible. In 1930 their exports were 132 million lbs and 22 million lbs respectively but in 1931 they rose to 145 million lbs and 26½ million lbs respectively. Also, it is roughly estimated by the advocates of Restriction (for no official figures have yet been published) that though in 1931 the total Indian tea crop amounted to about 385 million lbs. it rose to some 427 million lbs. in 1932. Again, the Restrictionists urge that the latest British Board of Trade figures show that stocks in

the United Kingdom at the end of 1932 were 303 million lbs. which is 41 million lbs. in excess of stocks at the end of 1931 and a record for all time.

FALLING PRICES.

Regarding tea prices, the *Financial Times* (London) in August 1932 recalled that "up to the last London sale of the 1931-32 season's crop the average price for the total sales of Northern India teas in 1932 was 11·15d. per lb. as compared with 1s. 0·84d. in the previous year. The Ceylon sales to date have averaged 1s. 0·16d against 1s. 2·78d. * * * The heavy drop in prices since the (British) Budget puts the matter in a worse light. The Northern India average fell from 10·17d. on 6th April to 7·58d. on 28th July: Southern India average from 10·41d. to 6·75d.; Ceylon from 1s. 4·34d. to 8·39d.; and Java from 7·51d. to 6·504d."

Referring to Calcutta sales the *Statesman* (Calcutta) on 14th January 1933 said: "During the present season there have been sold by public auction up to and including this week's sale 891,870 chests at an average price of As. 5 Pies 2 per lb. In 1931-32 during the

corresponding period there were sold 838,490 chests at As. 6 Pies 7 per lb. and in 1930-31, 771,528 chests at an average price of As. 9 Pies 7 per lb That is to say, in two years, sales have risen by 120,000 chests but the average price per lb has fallen by almost 4½ As Could the results of over-production on a falling market be better exemplified ?"

In their Tea Market Review for 1932 Messrs Brooke Bond & Co observe in March 1933 as follows. "Another disastrous feature is the constantly growing demand for the cheaper blends at the expense of good tea This feature is world-wide and is again no doubt due to economic conditions * * * The market for common tea has, every thing considered, been remarkably steady throughout the year, the highest quotation being 6¾d. in January and the lowest 5¼d. in September from whence it gradually rose to 6½d. Really fine tea has also held its own, but teas which in previous seasons would have ranked 'good to fine' have had a dramatic slump while ordinary medium tea fell to a figure very little over the price of common tea."

SUGGESTED SCHEME OF RESTRICTION.

There is not the remotest doubt that more regulation in plucking and some restriction of export are essential if widespread ruin is to be averted in this industry. Stocked tea gets out of condition very soon and so the lessening of output is imperative immediately The scheme cannot bring back the good old days even after the world's economic recovery, but it will help to save the industry from impending disaster. Intensive propaganda for tea consumption and new marketing methods by distributors have also become very essential. It is fortunate that in their own interests the Dutch growers have come into this Scheme and have further agreed to launch into a tea drinking propaganda which Ceylon has also decided to commence

The present world production is estimated to be about 20 per cent ahead of world consumption, but the dark clouds have a silver lining because Russia is coming back to the world's market. The Indian Tea Association in London has arranged for the sale to Centrosojus (England) Ltd of 7 million lbs. of tea for supply to Russia in 1933. The tea will

be supplied from a hunderd planting concerns purchased through auctions and provided on a twelve months' credit basis. The quantity may be increased by 3 million lbs in addition during this year.

The proposed scheme will operate for five years and is contingent on the support of local producers in India, Ceylon and the Dutch East Indies The scheme has been drawn up and accepted by the Committees of the Indian Tea Association, London, the South India Tea Association, London, the Ceylon Tea Association, London, and the Netherlands East Indies Growers. In the Dutch East Indies 91 per cent of the growers are reported to have approved of the scheme which is now being considered by the planters in India and Ceylon. The largest measure of assent, something like that of the Dutch growers, will be required from planters in India and Ceylon to ensure Government action and so the aforesaid Committees hope that there will be almost complete unanimity.

The scheme proposes to restrict foreign export merely, to leave home sales alone and

scarcely to touch regular production. Existing tea areas are not to be extended, except in special cases when the existence of an estate would otherwise be imperilled. In no circumstances, however, should extensions or new plantings exceed one half of one per cent of the present total area planted. It is estimated that in India there are now 183,137 acres of young tea not in bearing or only in partial bearing. The great object of the scheme is to restrict exports from the producing countries, such control being operated by their respective Governments.

The standard upon which regulation is based is the maximum export attained from India, Ceylon and the Dutch East Indies in any of the three years 1929, 1930 or 1931 reduced by 15 per cent. India's highest exports were during the 1929-30 season, when they reached the total of 382,594,779 lbs., the highest exports of Ceylon were in 1929 when they came to 251,522,617 lbs ; and the highest for Java and Sumatra was in 1931 when their exports were 145,028,631 lbs. and 26,533,397 lbs. respectively. Under the scheme, India's

exports will consequently be reduced from 382 million lbs to 325 million lbs, Ceylon's from 251 million lbs to 213 million lbs., Java's from 145 million lbs to 123 million lbs and Sumatra's from 26 to 22 million lbs.

Under this scheme there would be a slight rise in the 'cost of production,' as the result of less output, but on the other hand there is sure to be a rise in tea prices. The future of the industry, therefore, lies in the hands of the growers themselves. If the growers will produce flavoury teas with character, the distributors will be bound to sell them at better prices.

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